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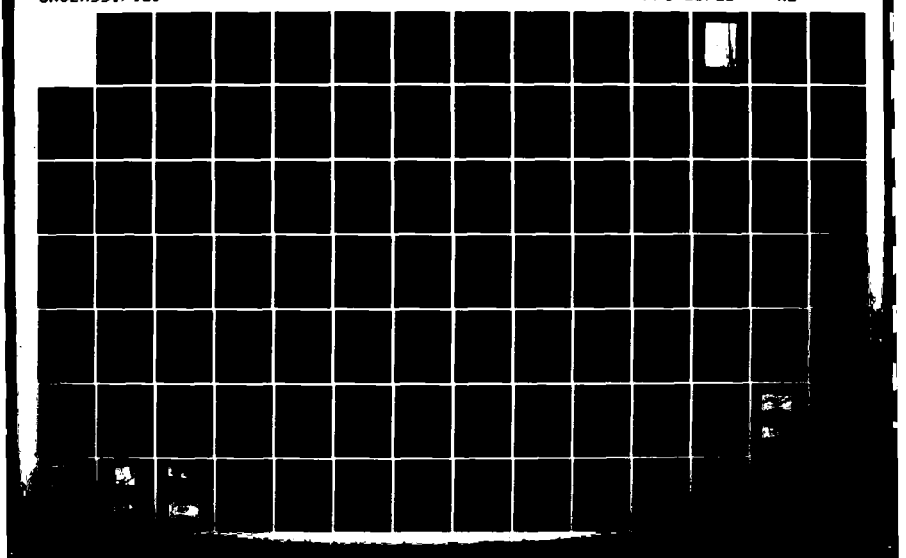

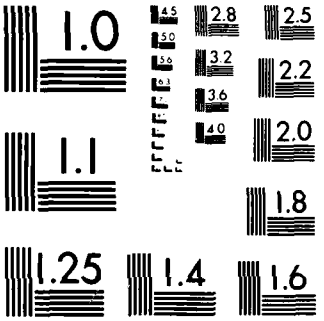

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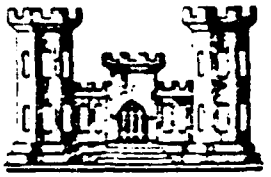
CONNECTICUT RIVER BASIN
BENTON , NEW HAMPSHIRE

OLIVERIAN DAM
NH-00268

(NHWRB 02306)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

MAY 1979

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DAMS, INSPECTION, DAM SAFETY,
Connecticut River Basin
Benton, New Hampshire
Oliverian Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is a zoned earthfill structure with 2-½ to 1 slopes and a top width of 16 ft. The dam is 46 ft. high and 1060 ft. long. THe dam is assessed to be in good condition. (The original hydrological and hydraulic design data computations were based on the assumption that the structure would have a moderate hazard potentila. There are several items of remedial maintenance which should be implemented by the owner.

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CONNECTICUT RIVER BASIN

BENTON, NEW HAMPSHIRE

OLIVERIAN DAM

NH-00268

(NHWRB-02306)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

NH-00268

OLIVERIAN DAM

BENTON

GRAFTON COUNTY, NEW HAMPSHIRE

OLIVERIAN BROOK

November 20, 1978

BRIEF ASSESSMENT

Oliverian Dam is a zoned earthfill structure with 2-1/2 to 1 slopes and a top width of 16 feet. The dam is 46 feet high and 1,060 feet long and has a maximum storage capacity of 2,700 acre-feet. The U.S. Department of Agriculture, Soil Conservation Service, Durham, ~~New Hampshire~~ was responsible for the design and construction of the dam.

Based on the visual inspection, review of design data and previous inspection reports, the ~~Oliverian~~ Dam is assessed to be in good condition. However, the existence of the extensive foundation and internal drainage system designed for the dam could not be verified during the field inspection. The functioning of this drainage system is critical to the stability of the dam, especially during any prolonged period of high water levels in the impoundment.

The original hydrologic and hydraulic design data computations were based on the assumption that the structure would have a moderate hazard potential. According to Soil Conservation Service guidelines, failure of a dam with a moderate hazard potential would not result in the loss of life. Based upon Corps of Engineers' guidelines, Oliverian Dam does pose a threat to life and is therefore classified as having a high hazard potential. Based on the dam's size classification (intermediate) and hazard potential (high), the test flood is the probable maximum flood (PMF) which has a routed peak outflow of 15,000 cfs. The total spillway capacity of the dam is about 5,800 cfs or 39% of the routed PMF. The test flood would overtop the dam by 2 feet. The routed peak outflow of the 1/2 PMF would not overtop the dam.

As a result of the Phase I investigation, it is recommonded that the following investigations and/or maintenance items be completed within one year of receipt of this report by the owner: 1) an engineering investigation to verify the existence and effectiveness of the toe drain and relief wells designed for the structure; 2) an engineering evaluation of the need for an improved trash rack design at the principal spillway; 3) the development of a formal warning system to be used in the event of an emergency; and 4) repair of Joint #2 of the discharge conduit (second joint upstream of the discharge end of the conduit).

Several items of remedial maintenance, as outlined in Section 7, should be initiated with completion to occur within 24 months of receipt of this report by the owner.

This Phase I inspection report was reviewed by both the U.S. Soil Conservation Service and the U.S. Forest Service. Comments received from these agencies are contained in Appendix B.

EDWARD C. JORDAN CO., INC.

Donald R. Cote

Donald R. Cote, P.E.
Vice President
Environmental Services

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Recommended Guidelines for Safety Inspection of Dams, the spillway test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

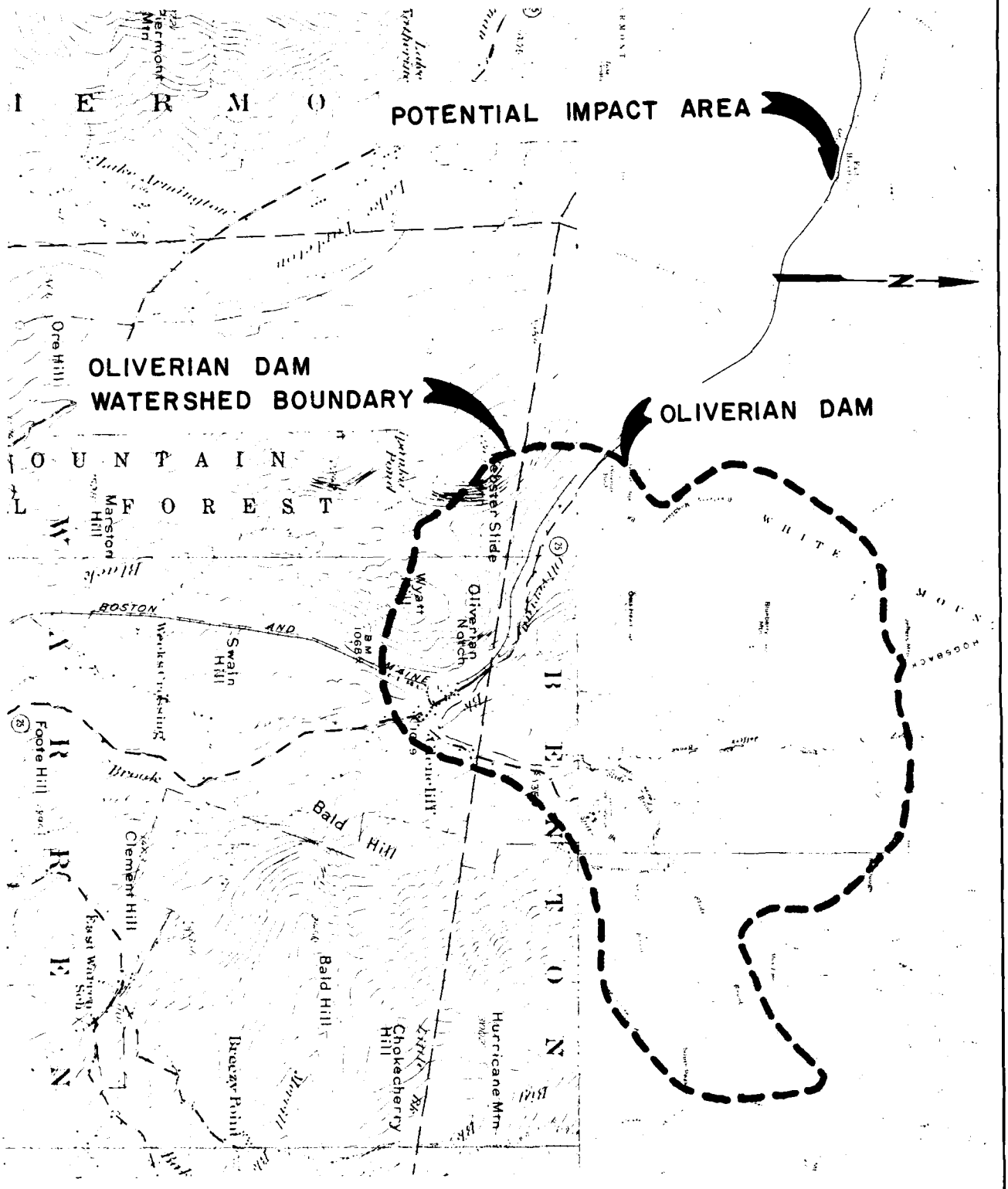
SECTION 5 - HYDRAULIC/HYDROLOGIC

SECTION 6 - STRUCTURAL STABILITY

SECTION 7 - ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

APPENDICES

OVERVIEW



EDWARD C. JORDAN CO., INC. PORTLAND, MAINE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

OLIVERIAN DAM
LOCATION & DRAINAGE AREA MAP

OLIVERIAN BROOK NH

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		DATE	APRIL 1978

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

OLIVERIAN DAM

SECTION 1

PROJECT INFORMATION

1.1 GENERAL

a. Authority. Public Law 92367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Edward C. Jordan Co., Inc. has been retained by the New England Division to inspect and report on selected dams in the states of Maine and New Hampshire. Authorization and notice to proceed were issued to Edward C. Jordan Company, Inc. under a letter of December 1, 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW3379C0017 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to initiate effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 DESCRIPTION OF PROJECT

a. Location. The Oliverian Dam is located on the Oliverian Brook in the town of Benton, New Hampshire. N 44°-00.5', W 71°-55.7'.

b. Description of Dam and Appurtenances. The Oliverian Dam is a zoned earthfill dam located in a broad, steep-sided valley. It is a flood control structure with a two-stage principal spillway and an emergency spillway. Both spillways have uncontrolled inlets. The principal spillway consists of a drop inlet concrete riser which discharges to a 48-inch diameter reinforced concrete conduit which passes through the dam (see Photos 3 and 5). The concrete conduit discharges to a plunge pool at the pipe outlet. (See Photos 8 and 9). The emergency spillway is a 100-foot wide, ungated, grass-lined earth channel. A pond drain inlet is located upstream of the principal spillway. Flow from the pond drain inlet to the drop inlet riser is controlled by a slide gate at the inlet structure. The Oliverian Campground is located immediately downstream of the dam. (See Photo 9).

c. Size Classification. Using the Corps of Engineers "Recommended Guidelines for Safety Inspection of Dams," Oliverian Dam is classified as an intermediate size dam based on both maximum storage capacity (2,500 acre-feet) and height (46 feet). According to the guidelines, an intermediate dam has a storage capacity in the range of 1,000 to 50,000 acre-feet or a height between 40 feet and 100 feet.

d. Hazard Classification. The Oliverian Dam is classified as having a high hazard potential. The peak flow from hypothetical failure of the dam was estimated to be 44,000 cfs based on the guideline procedures provided by the Corps of Engineers. Failure of the dam would result in river stages of approximately 12 to 13 feet at the town of East Haverhill, New Hampshire located 3.3 miles below the dam. Considerable damage would be expected in the town with a chance for the loss of many lives.

e. Ownership.

Current Owner: New Hampshire Water Resources Board
37 Pleasant Street
Concord, New Hampshire 03301

Previous Owner: None.

The Soil Conservation Service was responsible for the design and construction of the dam. The dam and reservoir is on land administered by the U.S. Forest Service.

f. Operator.

New Hampshire Water Resources Board

Contact: Vernon Knowlton
Tel: 1-603-271-3408

g. Purpose of Dam. Oliverian Dam is designed to provide temporary storage of flood waters to prevent flooding of primarily agricultural lands located below the dam.

h. Design and Construction History. The U.S. Department of Agriculture, Soil Conservation Service (SCS) designed the Oliverian Dam in 1959-1960. The dam was constructed in 1961-1962 by the Brookside Construction Company of East Hartford, Connecticut. Design and construction data and records are available at the SCS office in Durham, New Hampshire and are referenced in Appendix B-1 of this report.

i. Normal Operating Procedure. The Oliverian Dam is a self-operating flood control structure. The reservoir level is normally controlled by the ungated two-stage principal spillway consisting of a drop inlet structure which discharges through a 48-inch diameter concrete conduit constructed beneath the dam. The normal operation of the dam during periods of high runoff does not require an on-site operator. Periodic spot checks are reportedly made of the structure, and inspections are made annually. Personnel from the SCS, the New Hampshire Water Resources Board, and the U.S. Forest Service participate in these annual inspections.

1.3 PERTINENT DATA

a. Drainage Area. The drainage area above Oliverian Dam is 10.6 square miles. The watershed is almost entirely forested (see Photo 5). The terrain is characterized by moderately steep to very steep slopes. There are no other significant surface water bodies in the drainage area. Streambed slopes average about 350 feet per mile.

b. Discharge at Damsite. Oliverian Dam is provided with a pond drain, a tw -stage drop inlet principal spillway (ungated outlet works), and an emergency spillway. The principal and emergency spillways are ungated. The following discharges were obtained from Soil Conservation Service design data. Discharges given below assume a water surface elevation of 881.0 feet MSL (top of dam) unless otherwise noted.

ITEM	CAPACITY (CFS)
Principal spillway (ungated outlet works)	360
Emergency spillway	5,390
Maximum flood at damsite	Unknown
Total project discharge at test flood (PMF) at elev 883.1 feet	15,200
Total project discharge at 1/2 PMF at elev. 880.7 feet	5,400

c. Elevation. Mean sea level elevations were obtained from SCS design data information and cross-checked with field survey elevations.

ITEM	ELEVATION (FT ABOVE MSL)
Top of dam	881.0 ±
PMF pool	883.1
Emergency spillway crest	874.0
Principal spillway crest - low stage inlet	849.0
Principal spillway crest - high stage inlet	860.0
Design flood control pool	877.0
1/2 PMF pool	880.7
Streambed at centerline of dam	835.0
Maximum tailwater	Unknown
Normal water surface (top of design sediment storage pool)	849.0
Upstream invert of principal spillway concrete conduit	836.0

d. Reservoir Length.

ITEM	LENGTH (FEET)
Normal water surface	1400
Emergency spillway crest	3800
Full flood control pool	4100
Top of dam (elev. 881 ft)	4500

e. Storage.

ITEM	STORAGE CAPACITY (ACRE-FEET)
Normal water surface	164
Emergency spillway crest	1,804
Full flood control pool	2,153
Top of dam (elev. 881 ft)	2,664
PMF pool	3,000

f. Reservoir Surface.

ITEM	AREA (ACRES)
Normal water surface	30
Emergency spillway crest	106
Full flood control pool	120
Top of dam (elev. 881 ft)	140
PMF pool	150

g. Dam.

Type - Zoned earthfill dam

Length - 1060 feet ±

Height - From crest of embankment to streambed, the dam is about 46 feet high.

Top Width - 16 feet

Side Slopes - 2-1/2 horizontal to 1 vertical at both the upstream and downstream embankments. The upstream slope has a 10 foot berm at and a 3:1 slope below elevation 849 feet.

Zoning - The core consists of unified classification SM material with a top width of 16 feet and 2-to-1 side slopes. The shells are composed of unified classification GM-GW material, approximately 2 feet thick. See Appendix B.

Impervious Core - Unified classification SM material.

Cutoff - Key trench with 12 foot bottom width backfilled with SM material, depth varies from 0 to 10 feet.

Grout Curtain - Not applicable.

h. Diversion and Regulating Tunnel. Not applicable.

i. Spillway.

Type -

1) Principal spillway - uncontrolled, two-stage, drop inlet concrete riser discharging to a 48-inch diameter reinforced concrete conduit.

2) Emergency spillway - uncontrolled earth-lined saddle spillway.

Length -

1) Principal spillway - two weirs 3 feet - 2 inches long with crest elevation at 849 feet MSL and two weirs 12 feet long with crest elevation at 861 feet MSL (see Photo 3).

2) Emergency spillway - Crest length is 100 feet from sidewall to sidewall.

Crest Elevation -

1) Principal spillway:

a) High stage inlet - 860.0 feet MSL
b) Low stage inlet - 849.0 feet MSL

2) Emergency spillway - 874.0 feet MSL

Gates - None.

Downstream Channel -

1) Principal spillway - There is a plunge pool at the outlet of the concrete conduit. The banks of the plunge pool are protected against erosion by rip-rap. Below the plunge pool, the streambed is composed primarily of sand and gravel. The overbank area is primarily agricultural land. There is a recreation area directly downstream of the dam.

2) Emergency spillway - The emergency spillway discharges to the overbank area of the stream. The overbank area below the emergency spillway is covered with a moderate growth of brush and small trees.

Other - Principal spillway - The low level inlets (one on either side of riser) are provided with trash racks consisting of a rebar steel grill with 8-inch by 8-inch openings. The high stage inlets are provided with bar racks.

Emergency spillway - The emergency spillway has no trash control facility.

j. Regulating Outlets.

Invert Elevation - 836.5 feet MSL

Size - 30-inch diameter

Description - A 30-inch diameter concrete conduit extends approximately 50 feet from the riser out into the reservoir. The pond drain outlet is controlled by a slide gate at the principal spillway riser.

Control Mechanism - Manually operated lifting screw accessible from the top of the concrete riser (see Photo 6).

SECTION 2

ENGINEERING DATA

2.1 DESIGN

Oliverian Dam was designed by the U.S. Department of Agriculture, Soil Conservation Service (SCS) in 1960. The design included engineering studies of the hydrology of the watershed and the hydraulics of the dam and spillways; geotechnical evaluation of the foundation and embankment materials; and structural stability analyses under various hydraulic loadings.

2.2 CONSTRUCTION

The dam was built during 1961 and 1962 by Brookside Construction Company of East Hartford, Connecticut. It was completed and final acceptance was given on September 4, 1962. Records of construction were maintained by representatives of the SCS. During construction, quality control was maintained by the SCS. "As-built" drawings are available at the SCS office in Durham, New Hampshire. (Photostatic copies of selected sheets are included in Appendix B of this report).

2.3 OPERATION

Operation data consists of reports of inspections and remedial maintenance performed on the dam. Annual inspection reports for 12 of the 17 years since completion of the project were available for review. Copies of some of the annual inspection reports are contained in Appendix B.

2.4 EVALUATION

a. Availability. Design, construction and operation data are available at the Soil Conservation Service office in Durham, New Hampshire. A list of available data is included in Appendix B of this report.

b. Adequacy. The data made available by the SCS is deemed adequate for review of the project.

c. Validity. The evaluation of the SCS design and construction data disclosed two areas of concern regarding

the long-term safety of the structure. Of primary significance, the design called for the installation of an extensive subsurface drainage system within the dam. This drainage system, as designed, was to consist of rock toe drains and relief wells for control of the phreatic surface in the dam and hydrostatic pressure beneath the dam, and filters for prevention of piping. However, during the visual inspection, the presence of the designed toe drains or filters could not be confirmed. There is a possibility that the drains have been covered by soil fill.

The other area of concern pertains to the fact that the design spillway/storage capacity of the dam for flood control purposes was based on the dam being a Class B structure. According to SCS criteria, a Class B structure would not constitute a hazard to human life if failure were to occur. This evaluation has determined that there is a chance for significant loss of life if the structure were to fail with the water level to top of dam.

SECTION 3

VISUAL INSPECTION

3.1 FINDINGS

a. General. The Oliverian Dam is an earthfill structure located in a broad, steep-sided valley. It is a flood control structure with a two-stage principal spillway and an earth-lined emergency spillway. The Oliverian Campground is located immediately downstream of the dam.

b. Dam. The dam is approximately 46 feet high and 1,060 feet long. It has 2-1/2 to 1 side slopes and a 16 foot wide crest. The surfaces of the structure are vegetated with weeds and grass. See Appendices A, B and C for detail inspection findings, plans, sections, sketches, and photographs. The following major items were noted in the visual inspection:

(1) Structural.

a) The crest of the dam appears true to line and grade (see Photos 1 and 2). It is well vegetated and in good condition. The field survey made during the inspection indicated that a maximum vertical variation of 1 foot exists across the crest of the dam. At least a portion of this difference can be attributed to the variation in the densely matted vegetative cover on the crest.

b) The upstream slope appears stable and generally true to line and grade (see Photo 2). Several groundhog borrows were observed in the slope about elevation 860. The vegetation on the slope is in poor condition. Several areas are bare due to rodent activity, wave action, and trespass.

c) The downstream slope appears stable and the vegetation is fair to good. Some rodent activity is evident and several paths have developed from trespass.

d) Along the downstream toe of the dam seepage was noted in the area of Station 8+00 and a

wet area exists in the area of Station 4+50 (see Appendix B for stationing). The seepage at 8+00 was estimated to be 10 gpm or less and was not concentrated in any one area.

e) Seepage was observed around the outlet end of the principal spillway conduit. The seepage is coming through the riprap in this area and was estimated to be about 10 gpm. Some silt build-up on the riprap of the plunge pool was observed, but direct evidence of piping of soil from the earthfill could not be established. This seepage may represent the discharge from the internal drainage system, however, this could not be confirmed. Rust staining was observed near the area of the concrete discharge pipe outlet.

f) Some of the riprap along the sides of the plunge pool has been displaced and bank erosion is occurring.

g) The downstream rock toe drain was not visible. However, as shown on the "as-built" construction drawings supplied by the Soil Conservation Service the toe drain may be covered by earthfill.

(2) Hydraulics - During the visual inspection on November 20, 1978 the water level in the reservoir was at about elevation 850 feet. Water was entering the low stage inlets of the principal spillway. The low stage inlets are provided with steel grill trash racks with 8-inch x 8-inch openings. Two widely spaced bars form the trash rack for the high stage inlets. It was noted that large pieces of debris could enter the spillway riser. Apparently, the emergency spillway has never been used. During periods of high runoff, a reservoir operator is not needed at the dam. Inflow to the spillways occurs through uncontrolled inlets. Energy dissipation of principal spillway discharges is provided by a plunge pool. There is no designed energy dissipator at the outlet of the emergency spillway.

c. Appurtenant Structures. The principal spillway riser and outlet conduit were inspected as appurtenant structures. The concrete spillway riser was found to be in good condition with no evidence of serious erosion or spalling. The 48-inch diameter outlet conduit was also

found to be in good condition. It was observed that a 6-inch sag in grade occurs along the invert of the pipe near the centerline of the dam. The pipe joints are good except for Joint #2 from the downstream end which is cracked and spalled and is open about 1/2 inch. However, the bell and spiggot of the pipes still have adequate overlap. The slide gate of the pond drain outlet appeared to be in good operating condition.

d. Reservoir Area. The reservoir shoreline is primarily forested with moderate slopes above maximum water surface. No dwellings are located on the reservoir. No evidence of recent or potential slope failures was observed during the field inspection. The approaches to both the principal and emergency spillways were clear.

e. Downstream Channel. The channel of Oliverian Brook downstream of Oliverian Dam lies in a broad, flat valley section with steeply sloping sides. The channel slope averages approximately 3.4 feet per thousand. The streambed is composed primarily of sand and gravel with some cobbles. The overbank area is primarily pasture land. A plunge pool, acting as an energy dissipator, exists in the channel at the outlet of the principal spillway.

3.2 EVALUATION

Based on the visual inspection the dam appears to be in good condition. Some maintenance, as outlined in Section 7, is necessary to assure the long-term safety of the structure. It appears necessary that further investigation be made to establish the existence and effectiveness of the rock toe drain and filters.

SECTION 4

OPERATING PROCEDURES

4.1 PROCEDURES

The Oliverian Dam is a self-operating flood control structure. The reservoir level is controlled by a two-stage principal spillway and an emergency spillway. The principal spillway consists of a drop inlet structure which discharges to a 48-inch diameter concrete conduit constructed beneath the dam. The emergency spillway is a 100-foot wide, uncontrolled, grass-lined earth channel.

Periodic spot checks are reportedly made of the dam by New Hampshire Water Resources Board personnel. An annual inspection is performed by personnel of the Water Resources Board and representatives of the Soil Conservation Service and the U.S. Forest Service. Inspection records are available at the SCS office in Durham, New Hampshire.

An operator for the facility is not available in the immediate vicinity. Personnel responsible for the structure are located at the N.H. Water Resources Board office at Concord, N.H.

4.2 MAINTENANCE OF DAM

The Oliverian Dam appears to be generally well maintained. Conditions identified during the regular annual inspections are reportedly attended to by personnel of the N.H. Water Resources Board. A log of maintenance activities is kept at the Water Resources Board office in Concord, New Hampshire.

4.3 MAINTENANCE OF OPERATING FACILITIES

The only mechanical operating feature of the dam is a pond drain outlet. The gate stem for this drain was observed to be bent and a protective wood housing for the stem has been damaged. This gate was partially operated during the inspection and the damage noted did not appear to affect operation of the gate. The principal spillway facilities are maintained in good condition.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no formal warning system in effect. There is no means of remote monitoring of reservoir level.

4.5 EVALUATION

The Oliverian Dam is periodically inspected, and records are kept of inspection and maintenance activities. The inspection report file made available for this study did not contain reports for 1968, 1972-73, or 1975-76. Personnel responsible for the operation and maintenance of the dam are located at the New Hampshire Water Resources Board office in Concord, New Hampshire and are not readily available to view conditions at the dam. There is no formal warning system in effect. As outlined in Chapter 7, certain items of maintenance have apparently been neglected recently and are in need of attention.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. General. Oliverian Dam and reservoir is a flood control project designed by the Soil Conservation Service. The project consists of a 1060-foot long earthfill dam provided with a two-stage principal spillway and an emergency spillway. The principal spillway consists of a drop inlet structure which discharges to a 48-inch concrete conduit constructed beneath the dam. The concrete conduit discharges to a plunge pool at the pipe outlet. The emergency spillway is a 100-foot wide, non-gated, grass-lined earth channel.

b. Design Data. Original hydrologic and hydraulic design data was obtained from the Soil Conservation Service (SCS) office in Durham, New Hampshire. The Oliverian Dam was designed as a flood control project. The SCS classified the dam as a Class B structure indicating a moderate downstream hazard which corresponds to a potential serious economic loss in case of failure of the dam (but no loss of life). Using this classification, SCS criteria require that the dam be capable of safely passing, through a combination of storage and discharge, the runoff resulting from two-thirds of the probable maximum 6-hour precipitation.

The SCS used a runoff curve number-unit hydrograph approach to determine the inflow hydrographs resulting from the various storms used in the design of the principal and emergency spillways and the dam freeboard. The maximum precipitation used in design was 12.04 inches which resulted in 6.60 inches of runoff using a curve number of 60. Standard tables were used to determine storm distribution. The inflow hydrograph was constructed using a standard unit-graph which was determined from rainfall amount and runoff curve number. The reservoir routing was accomplished by a graphical procedure. The peak inflow of the freeboard hydrograph (maximum flood used in design) was 11,700 cfs. The routed peak was computed to be 5,700 cfs resulting in a reservoir water surface elevation at the dam of 880.8 feet.

The principal spillway was designed to pass, through a combination of storage and discharge, the 100-year flood flow. The 100-year flood discharge was assumed to result from the 100-year 6-hour precipitation. The emergency spillway crest was set at the elevation corresponding to the maximum storage required to pass the 100-year flood. The discharge capacity of the principal spillway was determined by the approximate bank full discharge capacity of Oliverian Brook (about 350 cfs).

A 50-year sediment volume of 164 acre-feet was provided in design.

c. Experience Data. No reports regarding specific hydrologic/hydraulic events was disclosed. It was reported by the SCS personnel at Dunham, N.H. that high water line to date is approximately 1 foot below emergency spillway crest.

d. Visual Observations. Erosion has occurred along the upstream face of the dam probably as a result of ice and wave action. This erosion has scoured portions of the protective vegetative cover and removed some of the earth embankment shell in places. It was also noted during the field inspection that the trash racks provided at the principal spillway appeared insufficient to prevent clogging.

e. Test Flood Analysis. Based on the Corps of Engineers "Recommended Guidelines for Safety Inspection of Dams," Oliverian Dam is classified as a high hazard dam (see Section f. below). Therefore, the test flood would equal the probable maximum flood. The drainage area above the dam is 10.6 square miles and was characterized as mountainous. The PMF was estimated to have peak inflow of 20,700 cfs. The routed peak outflow of the PMF was estimated to be 15,350 cfs. The inflow hydrograph was assumed to occur with initial reservoir water surface elevation at the crest of the low stage inlet of the principal spillway. The total spillway capacity of the dam would be capable of discharging about 39% of the estimated PMF. The PMF event would overtop the dam by 2.1 feet. The 1/2 PMF event would not overtop the dam (see Appendix D).

f. Dam Failure Analysis. To determine the hazard classification of Oliverian Dam according to Corps of Engineer guidelines, the potential impact of failure of the dam

at maximum pool (elev. 881 ft) was assessed. The failure analysis relied upon the "rule of thumb" guidance provided by the Corps of Engineers. The hazard potential was determined by calculating downstream dam failure hydrographs which might result from a breach of the dam.

The flood peak at the dam from failure was estimated to be 44,000 cfs. It would take the reservoir 1 to 2 hours to empty. At the town of East Haverhill, New Hampshire, located approximately 3.3 miles downstream of the dam, the peak flow from failure would be about 16,500 cfs resulting in river stages of 12 to 13 feet. Flood depths of 6 to 8 feet would likely occur in the town. Approximately 20 structures, many of which are residential, would be affected by high water levels. Therefore, the Oliverian Dam is classified as having a high hazard potential.

SECTION 6

STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Based on the visual observations, the Oliverian Dam appears to be in good condition. The crest and slopes of the dam appear true to line and grade. Trespassing has resulted in the formation of paths on the embankment slopes. Several groundhog burrows were observed during the field inspection. The vegetation on the slopes is generally fair to good, however, wave and ice action has caused erosion of the upstream slope from elevation 850 to 860±. Some minor seepage is occurring along the downstream toe of the dam and near the outlet of the principal spillway conduit. This may be the discharge from the rock toe drain, although this could not be verified during the visual inspection. The rock toe drain indicated on the construction drawings is not visible in the field. The status of this drain is of major concern because of its direct effect on the safety of the structure.

b. Design and Construction Data. Design and construction data is available at the SCS office in Durham, New Hampshire. The data available is referenced in Appendix B. Review of the design data indicates that a detailed assessment of the structural stability of the dam was made during design. Factors of safety consistent with current design practice were obtained during the structural stability investigations. The existence and effectiveness of the drains could not be confirmed during the investigation.

c. Operating Records. Records of inspections and maintenance activities are available. Review of these records indicates that inspections have been made on an annual basis (however, reports are available for only 12 of 17 years) and that maintenance has been done as necessary. These records indicate that a timber "flap gate" was installed in the principal spillway to protect the pond drain gate valve. This "flap gate" was not observed during the inspection.

d. Post-Construction Changes. The only post-construction change known is the installation of the "flap gate" discussed above.

e. Seismic Stability. No analysis of seismic stability was made during design of the project. The dam is located in Seismic Zone No. 2 and in accordance with Phase I guidelines does not warrant seismic analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Condition. Based on the visual inspection findings, performance history and a review of available design, construction and operation data, the Oliverian Dam is assessed to be in good condition. The structure appears to be generally well maintained and the visual inspection disclosed no evidence of serious distress. Analyses made during design stage disclosed the need for a toe drain and relief wells. The design and construction data indicate the existence of such drainage, however, its existence was not confirmed during the visual inspection nor during review of construction and post-construction photographs. Lack of drainage at the toe of the structure would present a potentially hazardous condition at the dam if the reservoir is maintained at a high level for a period of time sufficient to allow saturation of the embankment.

The hydraulic/hydrologic design of Oliverian Dam was carried out using generally accepted procedures for hydrograph development, reservoir routing, and hydraulic design. The dam appears to be constructed essentially as designed with respect to the hydraulic features of the project with the exception of the top of the south wall of the emergency spillway at the control section which appears to be about 0.5 feet lower than the design elevation. The major concern with the design data lies in the assumption of a Class B structure instead of a Class C structure. The latter would indicate a high hazard potential as opposed to a moderate hazard potential. The maximum precipitation used in design (12.04 inches) corresponds to approximately 60% of the probable maximum precipitation. Incorporated in the value of 12.04 inches was an area reduction factor which would not seem to be warranted. It is noted that the dam would be overtopped by about 2.1 feet by the PMF as developed using the Corps of Engineers guidelines. The spillway capacity is about 39% of the PMF, however, the 1/2 PMF would not overtop the dam.

The principal spillway appears to lack adequate trash racks. It was reported by the SCS that no problems have

developed from debris entering the principal spillway riser. However, it was noted during the inspection that the spaces in the trash rack could allow large pieces of debris to enter and the outlet conduit could potentially become clogged with no provision available to clear it.

b. Adequacy of Information. The information available is deemed adequate for the current Phase I assessment.

c. Urgency. The recommendations and remedial measures should be implemented within the time periods specified below in Sections 7.2 and 7.3. All time periods are assumed to start upon receipt of this report by the owner.

d. Need for Additional Investigation. Additional investigation is not considered necessary for the current assessment.

7.2 RECOMMENDATIONS

Further engineering evaluation of the hydrology of the watershed and hydraulics of the dam should be made within 24 months with regard to increasing spillway capacity with the findings being implemented as necessary.

Further engineering investigation should be initiated with completion to occur within 12 months to determine the existence and effectiveness of the rock toe drain and relief wells proposed in the design of the structure.

An engineering evaluation of the principal spillway should be completed within 12 months to determine the need for improved protection against debris clogging. This evaluation should result in the design and construction of an improved trash rack.

7.3 REMEDIAL MEASURES

a. Operating and Maintenance Procedures. The program of regular inspection and maintenance of Oliverian Dam should continue. Detailed inspections should be made by a qualified engineer every two years and frequent checks should be made by a designated operator, especially during periods of anticipated heavy runoff. The inspections should include a walk through the discharge conduit. Future inspections should also monitor the existing 6-inch sag in grade that occurs along the dis-

charge pipe (see Section 3.1.c.). The following specific maintenance and operating procedures should be implemented with time period for completion given in parentheses at the end of the item.

(1) The riprap along the sides of the stilling basin should be repaired (24 months).

(2) Joint #2 from the outlet pond of the outlet conduit should be repaired (12 months).

(3) The upstream slope of the embankment below elevation 865 should be reshaped. The slope should also be reseeded in areas dominated by weeds (24 months).

(4) The worn paths on the embankment should be reshaped and vegetated (24 months).

(5) Rodents living on and in the embankment should be exterminated and their burrows filled and surface areas re-vegetated (24 months).

(6) Provide around-the-clock surveillance during periods of anticipated high runoff (12 months).

(7) Develop a formal warning system and implement its use in the event of an emergency (12 months).

7.4 ALTERNATIVES

None.

APPENDIX A

VISUAL INSPECTION CHECKLIST

AND

SUPPLEMENTARY INSPECTION NOTES

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Oliverian Dam DATE 11/20/78

TIME P.M.

WEATHER Sunny, cold

W.S. ELEV. 850 U.S. 834 DN.S.

PARTY:

1. Stephen Cole 6.
2. John Devine 7.
3. David Nyman 8.
4. Tim Noonan 9.
5. Dan Lane 10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Geotechnical	Cole	
2.	Structural	Cole, Nyman, Devine	
3.	Hydraulics/Hydrology	Devine	
4.	Civil	Nyman	
5.	Survey	Noonan	
6.	Photography	Nyman, Devine	
	Review Inspection	Stanley Walker	
	11/30/78	Charles Horstmann	

No significant differences found from inspection of 11/20/78

NOTE: See Supplementary Inspection Notes Following Checklist

INSPECTION CHECKLIST

PROJECT Oliverian Dam DATE 11/20/78

PROJECT FEATURE Embankment NAME Cole

DISCIPLINE Geotechnical NAME

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	881
Current Pool Elevation	850±
Maximum Impoundment to Date	873±
Surface Cracks	None
Pavement Condition	Turf
Movement or Settlement of Crest	None apparent
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Groundhog burrows and foot paths
Sloughing or Erosion of Slopes or Abutments	Erosion has occurred on upstream face, wave cutting
Vegetation	Fair, some weeds and poorly vegetated areas.

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT (cont.)	
Rock Slope Protection - Riprap Failures	No riprap, upstream face, riprap failure near outlet pipe
Unusual Embankment or Downstream Seepage	Seepage near outlet pipe outfall
Piping or Boils	None
Foundation Drainage Features	None found
Toe Drains	None found
Instrumentation System	None

INSPECTION CHECKLIST

PROJECT Oliverian Dam DATE 11/20/78

PROJECT FEATURE Intake Channel/Structure NAME Cole, Devine

DISCIPLINE Geotechnical, Structural Civil NAME Nyman

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	Principal Spillway and Pond Drain Outlet
a. Approach Channel	
Slope Conditions	Generally flat
Bottom Conditions	Gravel
Rock Slides or Falls	None
Log Boom	None
Debris	Some stumps and logs
Condition of Concrete Lining	None
Drains or Weep Holes	None
b. Intake Structure	
Condition of Concrete	Good, no spall or cracks
Stop Logs and Slots	None
	NOTE: Low stage inlet trash rack is a #4 reinforcing steel cage with 8" openings.

INSPECTION CHECKLIST

PROJECT Oliverian Dam DATE 11/20/78

PROJECT FEATURE Control Tower NAME Cole, Devine

DISCIPLINE Structural, Civil Hydrology/Hydraulics NAME Nyman

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	Principal Spillway and Pond Drain
a. Masonry and Structural	
General Condition	Good
Condition of Joints	Good
Spalling	None
Visible Reinforcing	None
Rusting or Staining of Concrete	Some rust staining, north side near mid-height
Any Seepage or Efflorescence	None
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	None
Cracks	None
Rusting or Corrosion of Steel	Around inlet area of pond drain
b. Mechanical and Electrical	
Air Vents	None
Float Wells	None
Gate Hoist	None
Elevator	None

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER (cont.)	
Hydraulic System	None
Service Gates Emergency Gates	Pond drain gate valve in 30 inch pipe
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System	None

INSPECTION CHECKLIST

PROJECT Oliverian Dam DATE 11/20/78

PROJECT FEATURE Transition & Conduit NAME Cole

DISCIPLINE Structural, Civil NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Principal Spillway and Pond Drain
General Condition of Concrete	Good
Rust or Staining on Concrete	None
Spalling	None
Erosion or Cavitation	None
Cracking	See note below
Alignment of Monoliths	N/A
Alignment of Joints	See note below
Numbering of Monoliths	N/A

NOTE: Outlet conduit is a 48-inch diameter reinforced concrete pipe. Joint #2 from outlet end is open about 1/2" and cracked in two places. No leakage in pipe. Pipe grade sags near center of dike about 6 inches.

PERIODIC INSPECTION CHECKLIST

PROJECT Oliverian Dam DATE 11/20/78

PROJECT FEATURE Outlet Structure/Channel NAME Cole, Devine

DISCIPLINE Structural, Geotechnical Hydrology/Hydraulics NAME Nyman

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	Principal Spillway and Pond Drain
General Condition of Concrete	Good
Rust or Staining	None
Spalling	None
Erosion or Cavitation	None
Visible Reinforcing	Steel exposed at end of pipe
Any Seepage or Efflorescence	Seepage near pipe outlet through riprap
Condition at Joints	Okay
Drain holes	None found
Channel	
Loose Rock or Trees Overhanging Channel	None
Condition of Discharge Channel	Fair to good - some scour. Riprap failure has occurred on banks and some erosion has occurred.

INSPECTION CHECKLIST

PROJECT Oliverian Dam DATE 11/20/78

PROJECT FEATURE Spillway NAME Cole

DISCIPLINE Geotechnical, Hydraulics/ Hydrology NAME Devine

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	Emergency Spillway Earth-lined Saddle
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Vegetated
b. Weir and Training Walls	
General Condition of Concrete and Masonry	Note: Training walls are vegetated earth, natural ground on north sidewall, earthfill on south sidewall. No erosion at spillway floor or sidewalls.
Rust or Staining	
Spalling	
Any Visible Reinforcing	
Any Seepage or Efflorescence	
Drain Holes	
c. Discharge Channel	
General Condition	Fair
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Trees in channel
Floor of Channel	Turf and forest duff
Other Obstructions	

INSPECTION CHECKLIST

PROJECT Oliverian Dam DATE 11/20/78

PROJECT FEATURE Service Bridge NAME Nyman

DISCIPLINE Civil NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Superstructure	NOT APPLICABLE
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Under Side of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	NOT APPLICABLE

SUPPLEMENTARY INSPECTION NOTES

OLIVERIAN DAM
BENTON, NEW HAMPSHIRE

APPENDIX A

1. CONCRETE STRUCTURES IN GENERAL

a. Concrete Surfaces. The surfaces of the concrete in the outlet riser and the concrete pipe were found to be in good condition. No sign of spalling was observed, only minor rust-staining was observed inside of the outlet structure.

b. Structural Cracking. No cracking of the inlet riser was observed. The interior of the outlet pipe was also found to be free from structural cracks. Joint #2 from the downstream end in the outlet pipe was found to have been cracked in two areas and a small section approximately 2 inches by 4 inches had been spalled from the joint.

c. Movement, Horizontal and Vertical Alignment. The concrete structures show no evidence of abnormal movement. They appear true to line and grade.

d. Junctions. The earth embankment portion of the dam is essentially separate from the concrete inlet structure, however, the outlet pipe does run through the dam. There appear to be no evidence of distress between the earth section of the dam and the concrete.

e. Drains. No drains were observed at the dam structure.

f. Water Passages. The surface of the low stage and high stage inlet passageways to the outlet structure were found to be in good condition with no signs of erosion. The interior surface of the outlet pipe was also found to be in good condition with no sign of significant erosion.

g. Seepage or Leakage. No seepage or leakage was observed to be occurring into the outlet pipe. No seepage was observed to be occurring through the side walls of the inlet riser.

h. Monolith Joints and Construction Joints. All joints in the outlet riser were found to be tight and in good condition.

i. Foundation. The outlet riser appears to be founded on soil. No evidence of scour around the outlet structure or foundation distress was observed.

j. Abutments. There are no concrete abutments.

2. EMBANKMENT STRUCTURES

a. Settlement. Based on the visual inspection there is no evidence of general or localized settlement of the structure.

b. Slope Stability. The upstream and downstream slopes of the Oliverian Dam appear to be stable. No evidence of slope instability was found. The upstream slope of the embankment has undergone substantial erosion due to wave action. This erosion has not effected the overall stability of the slope at this time.

c. Seepage. Some seepage was observed to be occurring downstream of the toe of the dam near the northerly abutment below the emergency spillway. This seepage appears to be in an old streambed, located downstream of the dam. No particular point of seepage could be observed and is generally a large wet area. Seepage was observed to be occurring south of the outlet pipe at the toe of the dam and also directly beneath the outlet pipe. This seepage was estimated to be between 5 and 10 gpm and substantial rust staining has occurred in this area. Some build-up of silt in the riprap immediately downstream of this seepage area was observed. Some minor seepage is also occurring along the southerly toe of the dam in the form of a wet area. At the time of inspection the water level was only about 6 inches above the low stage inlet and the potential for downstream seepage was minimal.

A number of groundhog burrows were observed in the upstream slope of the dam at approximately the elevation of the high stage inlet. Two groundhog burrows were observed on the downstream slope. It appears that these are inactive burrows, however, they have not all been refilled. A substantial amount of mouse and mole activity has also occurred on the upstream slope causing raw areas and loss of vegetation.

3. SPILLWAY STRUCTURES

The spillway structures of the dam consist of the two-stage drop inlet riser constructed of concrete and an emergency saddle spillway located in the north abutment of the dam. The emergency spillway is a turf-lined channel.

a. Control Gates and Operating Machinery. The low stage and high stage discharge openings in the spillway outlet are not gated, however, a 30-inch pond drain gate exists. This gate valve was found to be operational.

b. Unlined Saddle Spillways. The emergency spillway located in the north abutment of the dam is an unlined saddle spillway. This spillway has a turf surface. The grass growth is intermixed with weeds and small brushes. Substantial erosion has occurred at and above the low stage water level on the pond end of the spillway. The spillway itself has a flat slope and appears to be resistant to erosion, however, the downstream end of this spillway is steep and shows evidence of some erosion due to rainfall.

c. Approach and Outlet Channel. The approach channel to both the low stage - high stage inlets of the principal spillway and the emergency spillway were found to be clear and unobstructed. The trash rack located around the low stage inlets consist of No. 4 rebar made into a grill of approximately 8-inch squares. The high stage inlet is protected by only two horizontal pipes. These pipes are at least 12 inches apart and it would apparently not limit the entrance of debris into the high stage inlet. One log was observed at the bottom of the outlet chamber. The approach to the emergency spillway was found to be clear and unobstructed. The outlet channel of the principal spillway was found to be clear and unobstructed. The outlet channel from the emergency spillway is covered with trees and could be easily obstructed by debris.

d. Stilling Basin. The stilling basin at the principal spillway outlet consists of a plunge pool with riprap banks. It was evident during the inspection that some erosion has occurred along the banks of the stilling basin. The bottom of the basin does not show evidence of deep scour or erosion. The downstream area of the emergency spillway shows no signs of serious scour or erosion indicating that the emergency spillway has probably never been utilized.

4. OUTLET WORKS

The pond drain outlet consists of a 30" diameter feeder pipe discharging to the concrete riser. There is a gated valve at the inlet to the riser which is operated from the riser. The pond drain outlet appeared to be operable.

5. SAFETY AND PERFORMANCE INSTRUMENTATION

None.

6. RESERVOIR

a. Shoreline. No permanent or temporary dwellings are located along the reservoir shoreline. The potential for slope failure along the reservoir shoreline appeared minimal. The shore is heavily forested with moderate slopes above maximum pool.

b. Sedimentation. No significant accumulation of sediment was observed. Sediment does not impede the approach to either spillway nor decrease the flood control capacity of the reservoir.

c. Potential Upstream Hazard. No potential upstream hazard was observed.

d. Watershed Runoff Potential. The drainage area consists primarily of lands of the White Mountain National Forest. Significant changes in watershed runoff potential are not expected to occur.

7. DOWNSTREAM CHANNEL

The channel of Oliverian Brook lies in a broad, flat valley section with steeply sloping sides. The channel slope is relatively flat. The streambed is composed primarily of sand and gravel. The overbank area is primarily pasture land.

8. OPERATING AND MAINTENANCE FEATURES

a. Reservoir Regulation Plan. The principal and emergency spillways are non-gated. The reservoir was designed to maintain the water surface elevation at the top of the sediment control pool.

b. Maintenance. Based on the visual inspection it appears that maintenance is performed on the dam on an as-needed

basis. The concrete structures are in good condition. The upstream and downstream slopes of the embankment portion of the dam have not been mowed. The crest of the dam has been mowed and brush has been cut on both the upstream and downstream slopes. The riprap below the outlet pipe has been eroded and lost along the stilling basin. This has not been repaired.

APPENDIX B

ENGINEERING DATA

This appendix lists the engineering data collected from project records and other sources of data developed as a result of the visual inspection. The contents of this appendix are listed below.

Appendix	Description
B-1	General Project Data
B-2	Past Inspection Reports and Review Comments from U.S. Soil Conservation Service and U.S. Forest Service

APPENDIX B-1

GENERAL PROJECT DATA

I. The following information is available through the U.S. Department of Agriculture Soil Conservation Service office in Durham, New Hampshire.

A. Preliminary design data and miscellaneous files (including benefit cost analyses, cost estimates, funding information, preliminary survey information, applications and approvals, newsclippings, and miscellaneous engineering information).

B. Correspondence and contract administration files.

C. Oliverian Brook work plan.

D. Design Data:

1. "Test Boring Reports for Oliverian Dam," Raymond Concrete Pile Company, May 10, 1960.

2. "Vertical Drain Design," January 31, 1961, Soil Conservation Service, Durham, New Hampshire.

3. "Stability Analyses," SCS Engineering and Watershed Planning Unit, Upper Darby, PA, 1960.

4. "Laboratory Results of Soils Analysis," Soil Mechanics Lab, SCS, Lincoln, Nebraska, August 29, 1960.

5. "Hydraulics and Hydrology," SCS, Engineering and Watershed Planning Unit, Upper Darby, PA, 1960.

6. "Structural Design - Oliverian Dam," SCS, Durham, New Hampshire, 1960.

7. "Bid Schedule," SCS, Durham, New Hampshire, December 1960.

8. "Geologic Report," SCS, Durham, New Hampshire, April 1960.

9. "As-Built Drawings, #NH-519-P," SCS, Durham, New Hampshire.

E. Other related plans:

1. General plan of recreation area at the dam

2. Plans for highway relocation around the dam site

G. Construction Data:

1. "As-built" drawings

2. Construction records

3. Job diaries

4. Cross-sections made for payment measurements.

5. Construction photographs

H. Copies of inspection reports and related correspondence

II. The following information is available at the New Hampshire Water Resources Board, 37 Pleasant Street, Concord, New Hampshire:

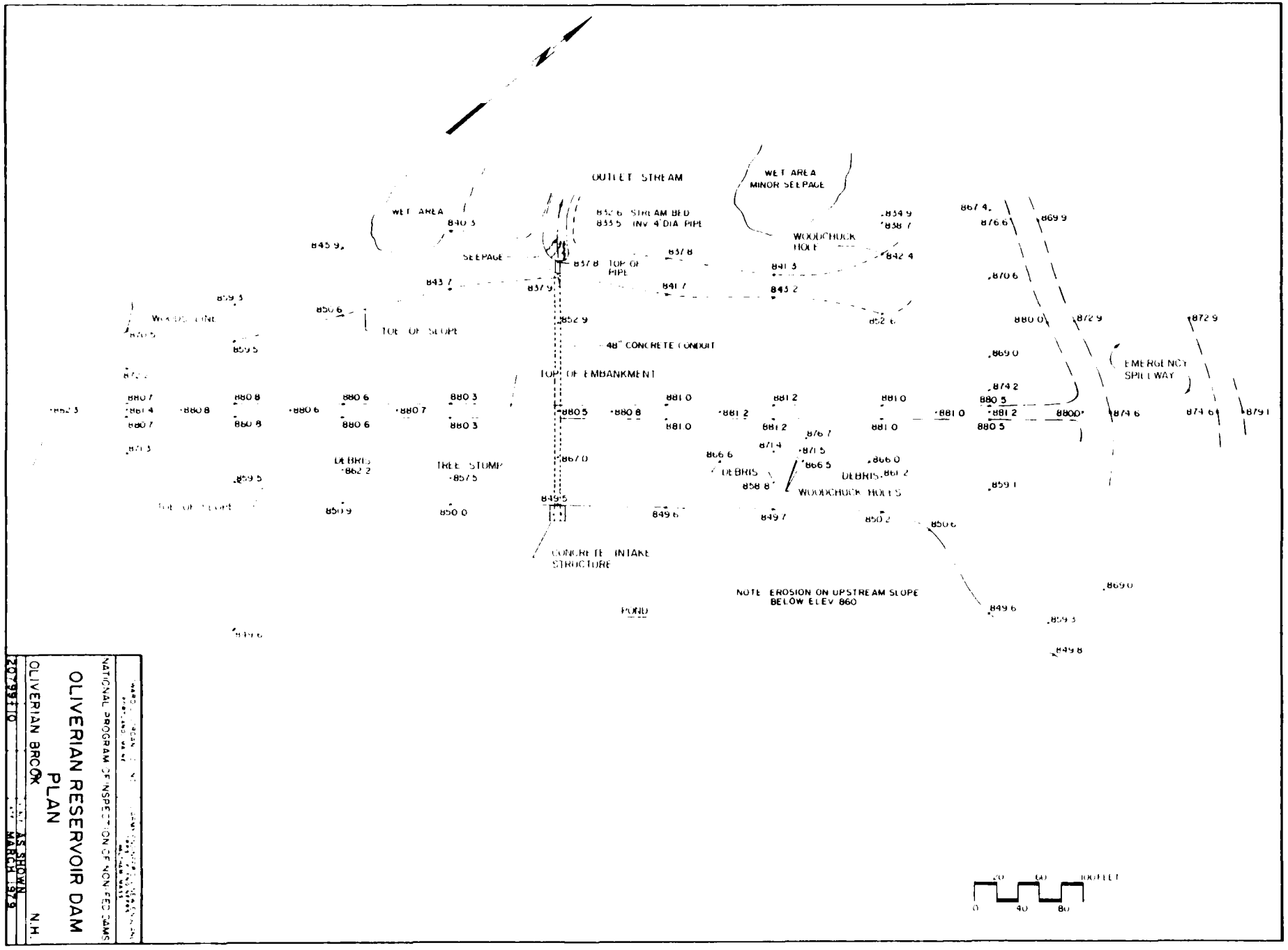
A. Miscellaneous correspondence and contract data relative to the Oliverian Dam

B. Miscellaneous photographs of the structure

C. Log of maintenance activities at the dam

D. Copies of some of inspection reports

III. The following sketch shows a plan of the Oliverian Dam with notes added based on the visual inspection. Also, following are reproductions of selected drawings from the "as-built" drawings of the dam.



OLIVERIAN RESERVOIR DAM

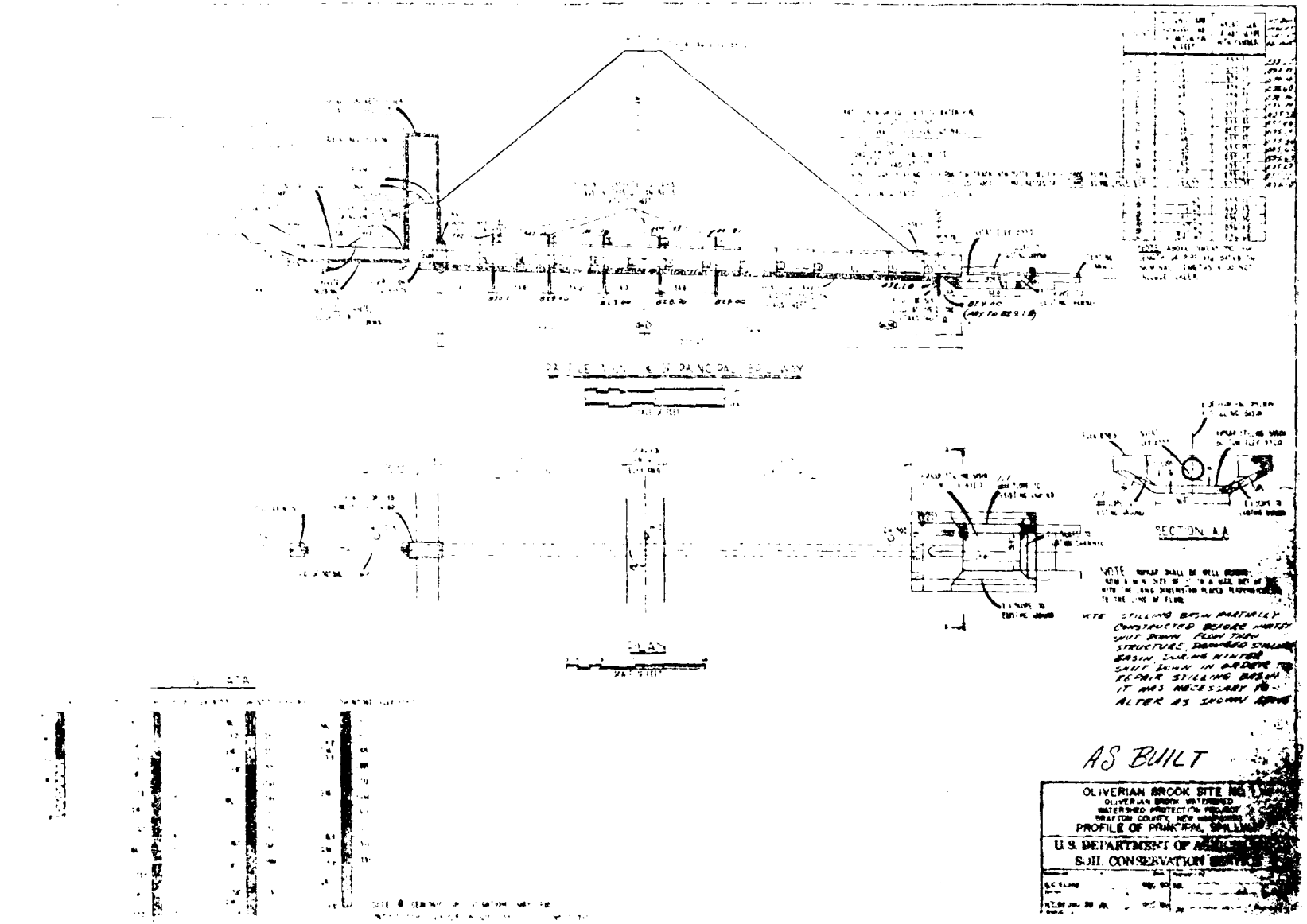
PLAN

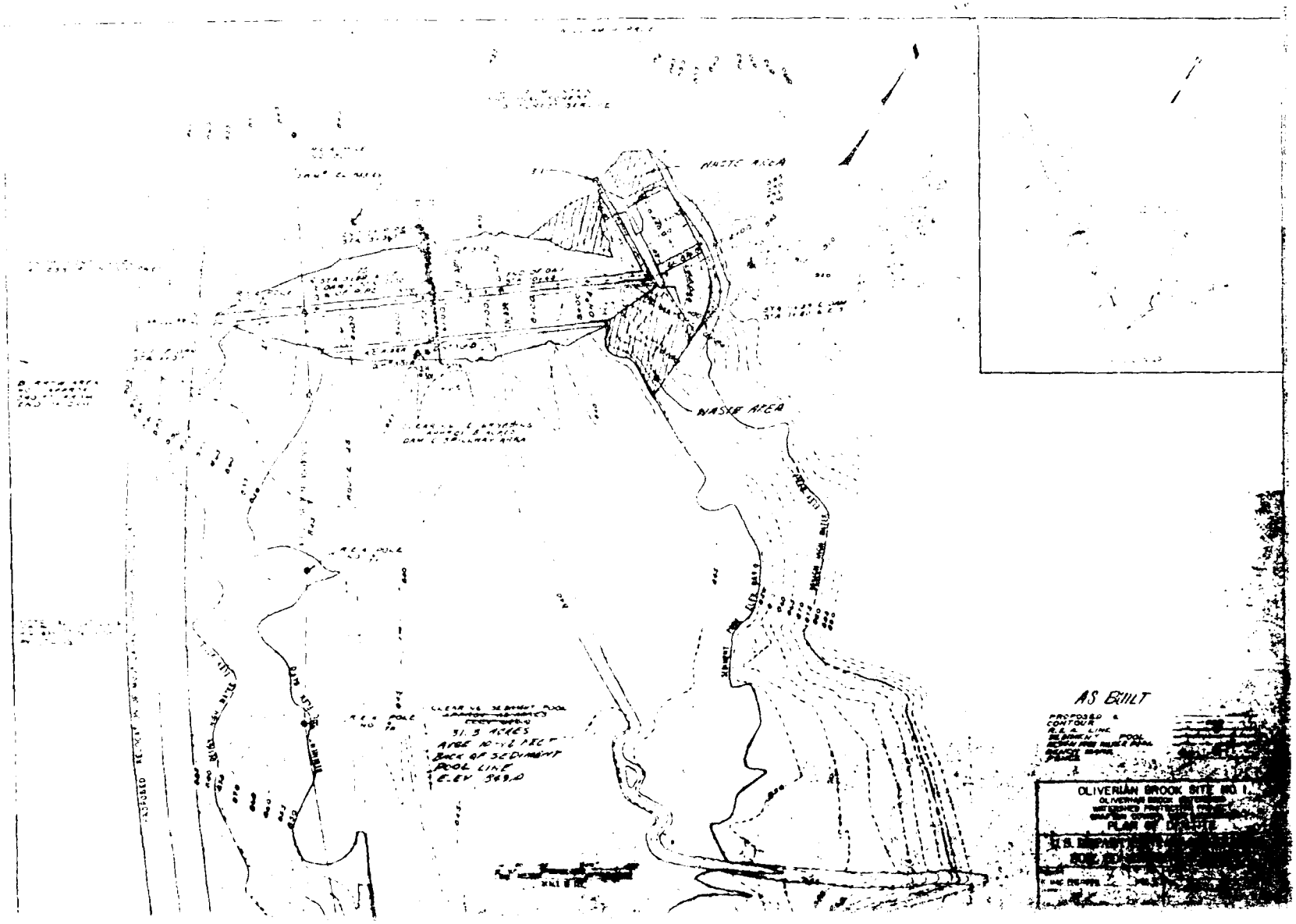
OLIVERIAN BROOK N.H.

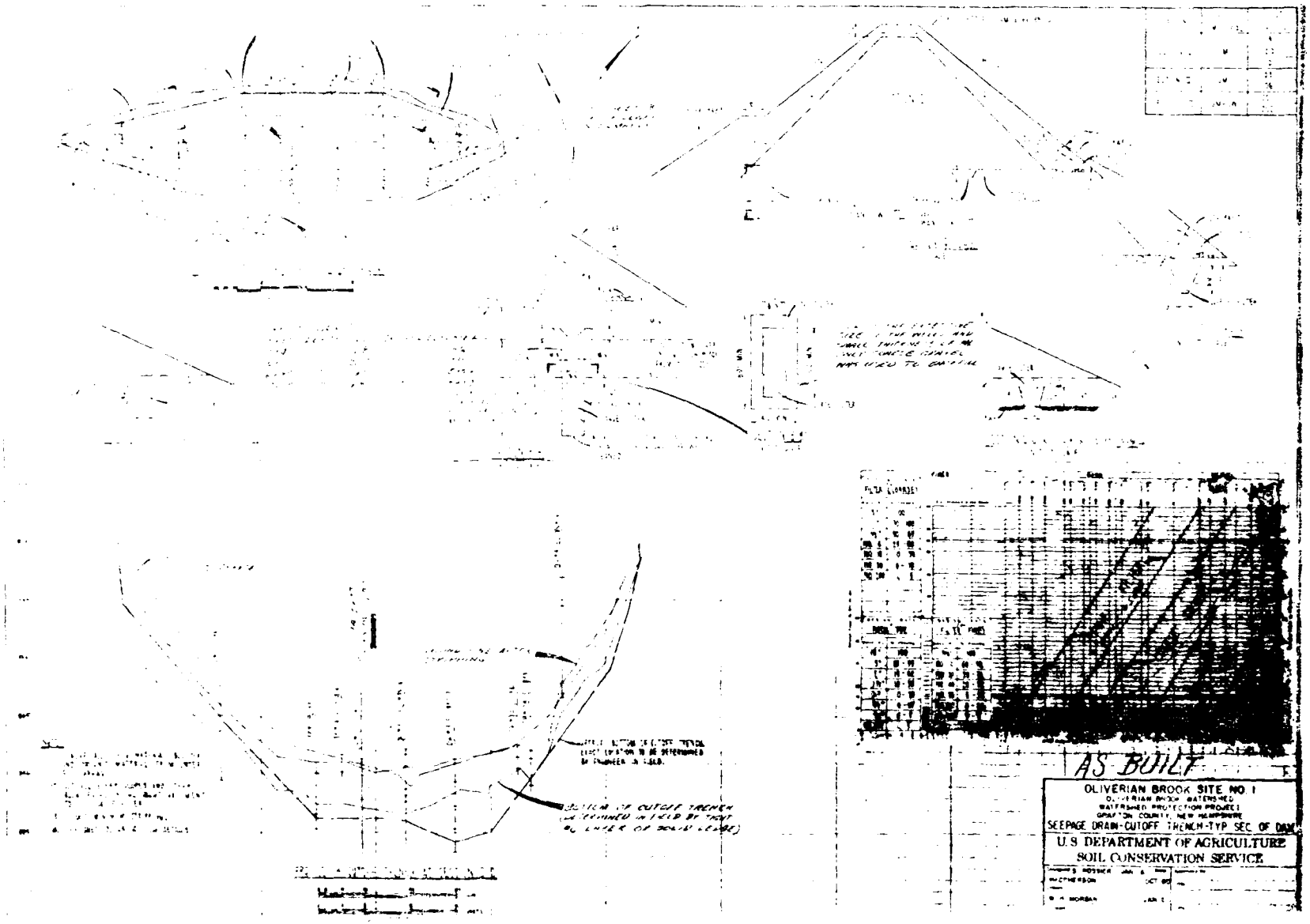
AS SHOWN

MARCH 1978

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS


SECTION A-A
PLAN
AS BUILT
OLIVERIAN BROOK SITE NO. 1
PROFILE OF PRINCIPAL SPILLWAY
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE


WASTE AREA
WASTE AREA
AS BUILT
OLIVERIAN BROOK SITE NO 1


AS BUILT
OLIVERIAN BROOK SITE NO. 1
OLIVERIAN BROOK WATERSHED
WATERSHED PROTECTION PROJECT
GRAFTON COUNTY, NEW HAMPSHIRE
SEEPAGE DRAIN-CUTOFF TRENCH-TYP SEC OF DAM
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

APPENDIX B-2

PAST INSPECTION REPORTS

AND

REVIEW COMMENTS

Attached are copies of inspection reports pertaining to the Oliverian Dam on file with the U.S. Department of Agriculture Soil Conservation Service office in Durham, New Hampshire. Also included are review comments obtained from the U.S. Soil Conservation Service and U.S. Forest Service on pages B-2.22 and B-2.23.

COPY

CLIVERIAN BROOK WATERSHED PROJECT
Hanover County, Virginia

Purpose: To report the findings of a joint inspection performed August 27, 1962 by Elmore Fuller, Conservation Officer, Graft n County Soil Conservation District and Donald Ferren, Work Unit Conservationist, Soil Conservation Service, on that part of the Oliverian project (Channel Improvement) completed in 1961.

Scope: The channel clearing, snagging and re-location extending down stream from the flood water retarding structure approximately 3.2 miles to the wooden bridge at East Haverhill, New Hampshire.

Findings: Since the channel improvement work was completed last fall, considerable sprouting and undesirable growth has taken place. This undesirable vegetative growth of brush and small trees tends to choke the channel capacity to a degree. It would appear that if allowed to continue their growth, the brush would effect the operation of this project by inhibiting the designed release rate from the dam. In our judgement, the area most needing immediate attention is a strip about 10 feet wide along the brook banks directly adjacent to the water. If this brush growth was destroyed, it would insure the proper operation of the project in the manner intended.

Recommendations: Use the report by Leslie Sargent, County Forester, "Research on Brush Control work on Oliverian Brook Watershed" as a guide. Have the sponsoring local organization obtain quotations ad proceed with spraying approximately 7 acres of the worst sprout and brush growth as soon as the necessary approvals and authorizations can be obtained. Preferably this week, so the recommended spray material (245T) can have at least 2 weeks to work before the first killing frost in the area.

Elmore Fuller

Elmore Fuller
Grafton County Soil Conservation District

Donald Ferren

Donald Ferren
United States Department of Agriculture
Soil Conservation Service

May 24, 1963

MAINTENANCE INSPECTION REPORT
of the
OLIVERIAN BROOK WATERSHED PROJECT

A joint operation and maintenance inspection of the Oliverian Brook dam and channel was conducted on May 24 by the following group:

Elmore Fuller, Grafton County Soil Conservation District
Leonard Frost, New Hampshire Water Resources Board
Kenneth Sutherland and Edward Glenty, U. S. Forest Service
Charles Brown, Donald Ferren, Keith MacPherson, and Jesse Hicks,
Soil Conservation Service

The purpose of the inspection was to determine the maintenance work needed on the dam and channel to insure the proper operation of the flood protection system.

The following is a list of items agreed upon by the group as needing attention:

I. DAM AREA

COPY

1. Clean debris off trash racks.
2. Clear debris off berm and upstream face of dam.
3. Remove stick from inside riser (lodged across inlet of 48" pipe).
4. Shape waterway running from low area behind shelter to outlet channel.
5. Smooth rough areas and vegetate outlet end of emergency spillway.
6. Divert brook flowing down to old railroad bed, so that it goes through highway culvert as originally graded.
7. Leaking at the drain gate was observed during the past winter resulting in some drop in the water in the permanent pool. The Soil Conservation Service will make an investigation of this leak sometime during the next few weeks and determine what action should be taken to prevent this from recurring.

Vegetative Work on Dam Area

1. A strip extending from normal water level to about 20-25 ft. up the south side of the embankment all the way across the dam needs to be regraded, fertilized, and reseeded. This will involve minor grading by pushing a small amount of fine soil from waterline up slope to blend into present vegetated area. Smooth and prepare seedbed and fertilize with 500 lbs. of 8-16-16 fertilizer. Incorporate the fertilizer into the soil and seed with a mixture of 10 lbs. Reed Canary grass and 10 lbs. Kentucky 31 tall fescue. Incorporate or roll seed into the surface layer by use of a roll or cultipacker.

This work is high priority and it is imperative to get this work done immediately to take advantage of the period that the water is drawn down in the pool to allow vegetation to be established.

2. There are a few rills or slips along the back slope on the east end of the spillway and on the north end of the spillway. These areas need to be patched by either placing additional fill in there or by raking in the edges so as to break up the continuous flow of water, and reseed with Kentucky 31 tall fescue.

3. It does not seem necessary to mow or topdress the area this season. However, it will need to be done next season.

4. The shallow waterway referred to above should be established between the toe of slope on the north side of the dam and the open shelter. This waterway will run from the abandoned culvert at the end of the old road to the present channel of the main stream. This will be a very shallow graded waterway. It will be necessary to fertilize and seed the disturbed area using 8-16-16 and Kentucky 31 tall fescue.

II CHANNEL WORK

The 3 miles of channel below the dam is generally in a good state of maintenance and is performing its function satisfactorily. Streambank erosion and bank sloughing was observed at two or three places. It is recommended that these areas be carefully observed on the next annual inspection and, if the problem becomes more acute, consideration should be given to placing dumped rock riprap at these locations.

The herbicides used on the sprout growth last fall, along the sides of the stream, seem to have been very effective. It does not need any work at this time.

William R. Mauk, Work Unit Conservationist
SCS, Woodsville, New Hampshire

June 7, 1967

Charles H. Dingle, State Conservation Engineer
SCS, Durham, New Hampshire

AS - Agreements 12 - Oliverian Brook Project

Attached is the Annual Maintenance Inspection Report for the Oliverian Brook Project conducted on May 15, 1967, by representatives of the New Hampshire Water Resources Board, U. S. Forest Service and the Soil Conservation Service.

We have listed in the report recommendations for maintenance work to be done on the dam and channel as discussed and agreed to by the group.

Please transmit copies of this report to the New Hampshire Water Resources Board, Grafton County SCD Supervisors and the U. S. Forest Service.

You should work closely with the New Hampshire Water Resources Board and others to see that the maintenance work is adequately carried out.

After all the work has been completed, please ask the Water Resources Board for a letter certifying the work has been done and the approximate cost for doing it. The cost data will be very helpful to the Watershed Planning Staff for estimating operation and maintenance in future work plans.

The maintenance inspection report and the sponsor's letter certifying the work has been completed should be kept in the work unit file. We would also like a copy of the letter certifying the completed work for the State Office file.

Attachment

cc: State Staff

COPY

COPY

MAINTENANCE INSPECTION REPORT

of the

Oliverian Brook Watershed Project

May 15, 1967

A joint operation and maintenance inspection of the Oliverian Brook Dam and channel was conducted on May 15, 1967. The representatives making the inspection of the dam and their respective organizations are listed below:

Forrest Hodgdon - Project Agent
New Hampshire Water Resources Board
Edward Gienty, Forest Engineer, Laconia, New Hampshire
Kenneth Sutherland, District Ranger, Plymouth, New Hampshire
U.S. Forest Service
William Hauck, Work Unit Conservationist, Woodsville, New Hampshire
Henry Stamatel, Design and Construction Engineer, Durham, New Hampshire

The same group, except for the Forest Service Personnel, conducted the inspection of the channel work.

The purpose of the inspection was to determine the maintenance work needed on the dam and channel to insure proper operation of the flood protection system:

The following is a list of items agreed upon by the group as needing attention:

Oliverian Dam

1. Clean debris off the trash racks.

2. Clean debris off berm and upstream face of dam.

3. There is small amount of erosion due to wave action on the upstream side of the dam. This is not considered serious at this time, although a small amount of sodding or spot seeding with Reed's Canarygrass would help in this area.

4. There has been some movement of rock riprap from the bottom of the stilling basin. No action is required on this.

5. About 60 - 80 feet downstream from the principal spillway outlet, bank erosion is taking place. This area should be riprapped with about 18 inches of riprap graded from 6 to 18 inches placed on a slope not steeper than 1 to 1.

6. Uniformly top dressing the dam and spillway area with 300 pound per acre of 8-16-16 fertilizer or equivalent. This should not be done after October 1.

7. Other items discussed included:

Mowing of the dam as a fire protection measure; this might be done periodically. Every three years was suggested. If done, this should be performed after the trefoil and desirable grasses have gone to seed. Such a delay would assist in maintaining the vegetative stand. The SCD will look into the cost of this and present the data to the New Hampshire Water Resources Board. The Water Resources Board has no objection to the Forest Service mowing areas around the periphery of the site or of any areas considered critical from the fire standpoint.

Also discussed, were the drainage improvements that might enhance the areas downstream from the dam (vicinity of picnic and camping areas). The drainage here is not a hazard to the dam safety, but, it does at certain seasons detract from the use of the recreational facilities. The Soil Conservation Service will provide technical assistance as required to assist in solving these drainage problems.

Channel work

The three miles of channel below the dam are operating satisfactorily. Remnants of two beaver dams in the lower reach of the channel are causing bank erosion. It is recommended that these dams be removed.

Bank erosion is taking place 500 - 700 feet upstream from the channel realignment work done in conjunction with the highway work. The landowner should be encouraged to riprap the severely eroding areas. He should request assistance through the regular conservation programs of the USDA.

Removal of fallen and overhanging larger trees would also be desirable.

MAINTENANCE INSPECTION REPORT
OF THE
OLIVERIAN BROOK WATERSHED PROJECT
JUNE 3, 1969

COPY

A joint operation and maintenance inspection of the Oliverian Brook dam and channel was conducted on June 3, 1969. The representatives, and their respective organizations, making the inspection are listed below:

Elmore Fuller, Grafton County Conservation District
Henry Stamatel, Soil Conservation Service, USDA
W. Michael Danneky, Soil Conservation Service, USDA
Forrest Hodgdon, New Hampshire Water Resources Board
Russell Rogler, U. S. Forest Service
Kenneth Sutherland, U. S. Forest Service

The following is a list of items agreed upon by the group as needing attention:

OLIVERSIAN DAM AND CHANNEL

1. Clean debris from trash racks and upstream side of dam.

2. Erosion due to wind and ice was noticeable adjacent to the structure on the upstream face of the dam. This erosion is still of a minor nature. Reed Canarygrass should be seeded or sprigged in this area in an attempt to stabilize the slope.

3. Some woody sprouts were observed on the dam. These sprouts should be cut and the stumps sprayed with brush killer.

4. The gate lift stem on the structure which controls the reservoir drain gate was bent, apparently due to ice and debris hitting it during high water. This stem should be straightened.

5. The outlet channel has some erosion and riprap displacement due to high water. The eroded areas should be riprapped and one to two feet of rock removed from the outlet end of the plunge pool.

6. The brook below the dam is becoming choked with alders and other woody growth, channel capacity is being reduced and the added weight is threatening to tear out sections of the bank. The woody growth should be sprayed with brush killer.

Generally -- The dam is in good sod and does not need topdressing at this time. There are still areas of Lackies meadow which need riprap.

1979

The Annual Inspection of completed PL 566 Watershed Structures for Grafton County was held on Monday June 15th. This inspection toured the Cliverian dam and channel and Sites 2-5-8 of the Baker River Watershed.

COPY

Those participating were:

F. Hodgdon - New Hampshire Water Resources Board
D. Rapoza - New Hampshire Water Resources Board
G. Fitzgerald - U.S. Forest Service
H. Stamatel - Soil Conservation Service, U.S.D.A.
D. Goodwin - Soil Conservation Service, U.S.D.A.
M. Dannehy - Soil Conservation Service, U.S.D.A.

Mr. Hodgdon and Mr. Fitzgerald only participated in the Oliverian inspection.

The following situations were noted and action on each recommended.

June 15 1970

OLIVERIAN DAM AND CHANNEL

A. Cut or otherwise kill alders and poplar growing on dam.

B. Replace stem on drain, or otherwise repair drain as it is leaking badly with resulting 1 foot drop in normal water level.

C. Remove trash from outlet structure and from face of dam and spillway.

D. Riprap outlet channel below impact basin. Use stone from bed of channel.

E. Study the desirability and feasibility of removing the alders and brush from the Oliverian Brook below the bridge on Route #25.

COPY

State of New Hampshire

WATER RESOURCES BOARD

STATE HOUSE ANNEX
CONCORD 03301

November 22, 1971

COPY

Mr. Michael Dannehy
District Conservationist
Soil Conservation Service
Plymouth, New Hampshire 03264

Dear Mike,

The following is a list of the work that was done at the Baker River Sites:

Oliverian Reservoir:

1. Placed riprap in scoured out areas of the outlet.
2. Cut all the brush both sides of the outlet brook from outlet pipe to the bridge.
3. Cut bushes that had sprouted on slopes of the dam.
4. Cleaned trash rack, bottles, driftwood, etc. along shoreline.
5. Cut bushes and dead white birch in emergency spillway and removed stones "Hippies" used for camp fires. Paul Natale had his Youth Conservation Corp. work with us on this project and they did a tremendous job.

Site Number 2:

1. Cleaned debris from trash rack.
2. Picked up and burned all the driftwood along the dam.
3. Put the cover back in its proper position on top of the concrete structure.
4. Filled the two holes with rocks and loam that were in the emergency spillway.
5. Trees were planted to stabilize the steep cut slope.
6. A barricade was placed at the end of the road to discourage vehicles from going on the emergency spillway.
7. Poster signs were put up to keep snow machines off the slope where the small trees were planted.

Site Number 5:

1. Replaced the broken cable at the entrance and strung cable through the wood posts to keep vehicles out.

2. Picked up all the driftwood and cleaned the trash rack.
3. Put up poster signs to keep mini bikes, etc. off the slopes.

Site Number 8:

1. Replaced the post at the cable entrance
2. Cleaned trash rack
3. Picked up all the driftwood and trash along shoreline.

B-2.11
Oliverian Dam

MAINTENANCE CHECKLIST FOR PL 566 FLOOD CONTROL STRUCTURES

This maintenance checklist is a guide for determining the maintenance required for Public Law 566 flood control structures in New Hampshire. It doesn't take the place of experience and judgment and is not inclusive. Items of a difficult nature to check, such as principal spillway conduit condition, are not included. Intensive checks of these items are necessary at proper intervals. Review of As Built drawings, the design folder, structure history, and previous maintenance reports should be part of the inspection. Prompt maintenance is a vital part of safe and effective operation.

Except where otherwise indicated, completion of this form may be facilitated by ranking maintenance items on a 1 to 4 basis where

1 = satisfactory
2 = satisfactory, but check carefully at next inspection
3 = requires maintenance this season
4 = requires immediate attention.

COPY

WATERSHED OLIVERIAN BROOK SITE 1 DATE 5-30-77
INSPECTED BY KERR DANNEHY LUNTALA MILLIGAN KELSEY MACPHERSON

1. GENERAL ITEMS

Access Road.	1
Site Fencing.	2
Traffic Conditions.	2
Vandalism Control.	2
Trash Control.	1

COMMENTS LARGE ROCKS FORMING ROCK BARRIER AT TOE OF DAM HAVE BEEN MOVED & ATV'S HAVE GONE UP SLOPE OF DAM

2. RESERVOIR

Timber stand at reservoir.	1
Debris and slash.	2
Sediment level in relation to low stage inlet	1

COMMENTS TRASH ON FRONT FACE OF DAM

COPY 2

3. EMBANKMENT AND EXCAVATED SLOPES

(Report riprap and vegetation and erosion condition under Items 4 and 5.)

	Dam	Dike	Emergency Spillways left	Emergency Spillways right 1/	Other (____)	Other (____)
Sliding or sloughing	3	—	—	2	—	—
Holes (rodent and other) (check especially at embankments)	1	—	—	1	—	—
Excessive settlement (embankments)	1	—	—	1	—	—
Cracks						
Traverse	1	—	—	1	—	—
Longitudinal	1	—	—	1	—	—
Seepage 2/	1	—	—	1	—	—
Piping 2/	1	—	—	1	—	—

COMMENTS FRONT FACE OF DAM HAS BEEN GOUGED BY ICE TO AN ELEV. OF 5 TO 6 FT. ABOVE NORMAL POOL LEVEL. THERE IS EROSION OCCURING ON THE DOWNSTREAM FACE OF THE DAM WHERE PEDESTRIAN TRAFFIC & WHEEL-CUTS FROM ATV'S HAVE WORN VEGETATION DOWN. THERE IS A SMALL GULLY STARTED AT ONE POINT.

4. RIPRAP

	Displ. of Rock	Loss of Spalls	Loss of Bedding	Erosion of Found.	Break-down of Rock
Dam					
Upstream berm	—	—	—	—	—
Principal Spillway Outlet	—	—	—	—	—
Embankment Gutters					
left	—	—	—	—	—
right	—	—	—	—	—
Emergency Spillway					
location _____	—	—	—	—	—
location _____	—	—	—	—	—
Waterways					
location _____	—	—	—	—	—
location _____	—	—	—	—	—
Outlet Channel	—	—	—	—	—
Other PLUNGE POOL	3	3	—	3	1

COMMENTS ROCK HAS BEEN DISPLACED IN THE PLUNGE POOL - PARTICULARLY ON THE RIGHT SIDE.

1/Looking downstream.
2/Check especially at downstream face of embankments.

COPY

5. VEGETATION

	Dam	Emergency Spillways left	Emergency Spillways right 1/	Dike	Outlet Channel	Water way	Other (_____)
Condition of stand (including need for lime and fertilizer)	2	—	2	—	1	—	—
Undesirable vegetation	3	—	1	—	1	—	—
Drainage (surface)	NA	—	1	—	NA	—	—
Erosion 2/	3	—	1	—	1	—	—
Sedimentation	1	—	1	—	1	—	—
Condition of planting	NA	—	NA	—	NA	—	—
Pest control PLANT	1	—	1	—	1	—	—
Fire control	—	—	—	—	—	—	—

COMMENTS SMALL AMOUNT OF BRUSHY GROWTH ON DAM. ONE SMALL GULLY AT CREST OF DAM. CROWN VETCH IS APPARENTLY SPREADING. BASICALLY A WEED COVER ON UPSTREAM FACE OF DAM. PH = 6.0 ON THIS FACE

6. EMBANKMENT, STRUCTURAL, & OTHER DRAINS

		Dam left	Dam right 1/	Other (____)	Other (____)
Depth of Flow (in inches above invert)	With any obstruction	—	—	—	—
	Without any obstruction	—	—	—	—
Turbidity of Discharge (yes, no)	With any obstruction	—	—	—	—
	Without any obstruction	—	—	—	—
Condition of Protective Coating	Outside	—	—	—	—
	Inside	—	—	—	—
Obstruction in Flow (yes, no)		—	—	—	—
Animal Guard Condition		—	—	—	—
Outlet Condition		—	—	—	—

Retarding Pool Elevation (ft. msl)_____ or_____(ft.) above / below _____

Other_____

COMMENTS_____

1/ Looking downstream.

2/ Including wind, surface, stream, manmade, and livestock erosion.

7. RISER

Caution Be extremely careful when using ladders. Check condition before using. Ladders are sometimes broken, loose, corroded, and or slippery.
Use safety harness.

Ladders: NONE
inside and out

Condition of protective coating___; Corrosion___; Damaged parts___; Loose___; Other___.

Concrete:
inside and out

Cracking 1; Spalling 2; Other deterioration 2; Excessive movement (check joint at riser and conduit)___; Other___.

Trashracks:
low and high stage

Condition of protective coatings 3; Corrosion 1; Damaged parts 3; Condition of fastenings ___; Need of gratings due to beaver 1; Safety condition (protruding fastenings, sharp edges, etc.) 1; Other 1.

Manhole:

Condition of protective coatings___; Corrosion ___; Damage___; Lock operable___; Other___.

Gate:
including lifting device, stem, guides, disc

Condition of protective coating___; Corrosion ___; Damaged parts___; Condition of fastenings___; Stem alignment___; Lubrication___; Operation___; Other___.

Safety Items:

Condition of warning signs___; Condition of safety equipment___; Other___.

COMMENTS W.R.B. PERSONNEL WILL CHECK RISER AND APPURTENANCES AT A LATER DATE. SPALLING VISIBLE ON TOP SLAB. RIGHT SIDE POCKMARKED - PROBABLY BULLETS. L.S. TRASH RACK IS RUSTING & SOME BARS ARE BENT. THE WELD BETWEEN SOME BARS IS ALSO BROKEN.

8. IMPACT BASIN, SAF, BOX INLET, & MISCELLANEOUS CONCRETE STRUCTURES

(specify)_____ _____

Concrete: inside and out	Cracking___; Spalling___; Other deterioration ___; Excessive movement (check joints)___; Waterstops___; Joint sealant___; Other___.
Trashracks: low and high stage	Condition of protective coatings___; Corrosion ___; Damaged parts___; Condition of fastenings___; Need of gratings due to beaver___; Safety condition (protruding fastenings, sharp edges, etc.)___; Other___.
Gates: including lifting device, stem, guides, disc, flap	Condition of protective coating___; Corrosion ___; Damaged parts___; Condition of fastenings___; Stem alignment___; Operation___; Lubrication___; Wood decay___; Other___.
Structure Drainage:	Report under "Embankment and Other Drains"
Structure, Railing, Grates, Barriers, etc.	Condition of protective coating___; Corrosion ___; Damaged parts___; Condition of Fastenings___; Wood decay___; Safety condition (protruding fastenings, sharp edges, etc.) ____; Other___.
Safety Items:	Condition of warning signs___; Condition of safety equipment___; Other___.

COMMENTS_____

COPY

9. CHANNEL

Stream obstructions.	3
Debris in stream.	3
Sediment bars controlled.	-
Plunge pool stability.	3
Fish habitat appurtenances	-

Riprap -- Report under "Riprap" (item 4)

COMMENTS SOME RIPRAP FROM PLUNGE POOL HAS MOVED INTO STREAM BELOW POOL.

MAINTENANCE CHECKLIST FOR PL 566 FLOOD CONTROL STRUCTURES

This maintenance checklist is a guide for determining the maintenance required for Public Law 566 flood control structures in New Hampshire. It doesn't take the place of experience and judgment and is not inclusive. Items of a difficult nature to check, such as principal spillway conduit condition, are not included. Intensive checks of these items are necessary at proper intervals. Review of As Built drawings, the design folder, structure history, and previous maintenance reports should be part of the inspection. Prompt maintenance is a vital part of safe and effective operation.

Except where otherwise indicated, completion of this form may be facilitated by ranking maintenance items on a 1 to 4 basis where

1 = satisfactory
2 = satisfactory, but check carefully at next inspection
3 = requires maintenance this season
4 = requires immediate attention.

COPY

WATERSHED Oliverian SITE 1 DATE 6-13-78

INSPECTED BY Gary Kerr, Lyall Milligan (WRB); Mike Dannehy, Nick Luhtala, Ray Wenninger (SCS)

1. GENERAL ITEMS

Access Road.	(4)
Site Fencing.	--
Traffic Conditions.	(4)
Vandalism Control.	1
Trash Control.	1

COMMENTS There are two areas on the left end of the dam where traffic is getting onto the top of the dam. These areas should be blocked off. Little trash is evident.

2. RESERVOIR

Timber stand at reservoir.	1
Debris and slash.	3
Sediment level in relation to low stage inlet	1

COMMENTS Some trash at the upstream face of the dam and at the riser should be removed.

SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

3. EMBANKMENT AND EXCAVATED SLOPES

(Report riprap and vegetation and erosion condition under Items 4 and 5.)

	Dam	ES Dike	Emergency Spillways 1/ left	Emergency Spillways 1/ right	Other (____)	Other (____)
Sliding or sloughing	1	1	—	1	—	—
Holes (rodent and other) (check especially at embankments)	1	1	—	1	—	—
Excessive settlement (embankments)	1	1	—	—	—	—
Cracks						
Traverse	1	1	—	—	—	—
Longitudinal	1	1	—	—	—	—
Seepage 2/	1	1	—	1	—	—
Piping 2/	1	1	—	1	—	—

COMMENTS

COPY

4. RIPRAP

	Displ. of Rock	Loss of Spalls	Loss of Bedding	Erosion of Found.	Breakdown of Rock
Dam					
Upstream berm	—	—	—	—	—
Principal Spillway Outlet ✓	3	3	3	1	1
Embankment Gutters					
left	—	—	—	—	—
right	—	—	—	—	—
Emergency Spillway					
location_____	—	—	—	—	—
location_____	—	—	—	—	—
Waterways					
location_____	—	—	—	—	—
location_____	—	—	—	—	—
Outlet Channel	—	—	—	—	—
Other_____	—	—	—	—	—

COMMENTS Some riprap is needed at the principal spillway outlet. The existing rock appears to be inadequate as there is a little bank erosion at outlet. Not major.

1/Looking downstream.
2/Check especially at downstream face of embankments.

5. VEGETATION

	Dam	Emergency Spillways left	Emergency Spillways right 1/	Dike	Outlet Channel	Water way	Other (_____)
Condition of stand (including need for lime and fertilizer)	1	1	1	—	—	—	—
Undesirable vegetation	(3)	—	(3)	—	—	—	—
Drainage (surface)	—	—	—	—	—	—	—
Erosion 2/	(3)	—	—	—	—	—	—
Sedimentation	—	—	—	—	—	—	—
Condition of planting	(3)	—	(3)	—	—	—	—
Pest control	—	—	—	—	—	—	—
Fire control	—	—	—	—	—	—	—

COMMENTS Vegetation reverted to native grasses. Vetch-Bluegrass looks good on dam. Some brush on dam, some scour on toe. Emergency spillway has some bare spots. Needs spot revegetation. Upstream face of dam has some erosion at waterline; approximately 1 to 2 feet deep. Suggest treatment this year to keep maintenance to a minimum. Believe it is caused by ice, waves, and foot traffic.

6. EMBANKMENT, STRUCTURAL, & OTHER DRAINS

		Dam left	Dam right 1/	Other (_____)	Other (_____)
Depth of Flow (in inches above invert)	With any obstruction	—	—	—	—
	Without any obstruction	—	—	—	—
Turbidity of Discharge (yes, no)	With any obstruction	—	—	—	—
	Without any obstruction	—	—	—	—
Condition of Protective Coating	Outside	—	—	—	—
	Inside	—	—	—	—
Obstruction in Flow (yes, no)		—	—	—	—
Animal Guard Condition		—	—	—	—
Outlet Condition		—	—	—	—

Retarding Pool Elevation (ft. msl)_____ or_____(ft.) above / below _____

Other_____

COMMENTS No exposed drain pipe outlets.

1/Looking downstream.

RISER

Caution Be extremely careful when using ladders. Check condition before using. Ladders are sometimes broken, loose, corroded, and or slippery.
Use safety harness.

COPY

Ladders: inside and out	Condition of protective coating___; Corrosion___; Damaged parts___; Loose___; Other___.
Concrete: ~~inside~~ and out	Cracking 1 ; Spalling 1 ; Other deterioration 1 ; Excessive movement (check joint at riser and conduit)___; Other___.
Trashracks: low and high stage	Condition of protective coatings___; Corrosion 1 ; Damaged parts 1 ; Condition of fastenings 1 ; Need of gratings due to beaver___; Safety condition (protruding fastenings, sharp edges, etc.)___; Other___.
Manhole:	Condition of protective coatings___; Corrosion ___; Damage___; Lock operable___; Other___.
Gate: including lifting device, stem, guides, disc	Condition of protective coating___; Corrosion ___; Damaged parts___; Condition of fastenings___; Stem alignment___; Lubrication___; Operation___; Other___.
Safety Items:	Condition of warning signs___; Condition of safety equipment___; Other___.

COMMENTS Did not check inside of riser or gate operation. Suggest this be done at regular intervals.

(specify)_____ _____

Concrete: inside and out	Cracking___; Spalling___; Other deterioration ___; Excessive movement (check joints)___; Waterstops___; Joint sealant___; Other___.
Trashracks: low and high stage	Condition of protective coatings___; Corrosion ___; Damaged parts___; Condition of fastenings___; Need of gratings due to beaver___; Safety condition (protruding fastenings, sharp edges, etc.)___; Other___.
Gates: including lifting device, stem, guides, disc, flap	Condition of protective coating___; Corrosion ___; Damaged parts___; Condition of fastenings___; Stem alignment___; Operation___; Lubrication___; Wood decay___; Other___.
Structure Drainage:	Report under "Embankment and Other Drains"
Structure, Railing, Grates, Barriers, etc.	Condition of protective coating___; Corrosion ___; Damaged parts___; Condition of Fastenings___; Wood decay___; Safety condition (protruding fastenings, sharp edges, etc.) ____; Other___.
Safety Items:	Condition of warning signs___; Condition of safety equipment___; Other___.

COMMENTS_____

COPY

9. CHANNEL

Stream obstructions. . . . . ____
Debris in stream. . . . . ____
Sediment bars controlled. . . . . ____
Plunge pool stability. . . . . ____
Fish habitat appurtenances . . . . . ____
Riprap -- Report under "Riprap" (item 4)

COMMENTS Channel looks fairly good. Should remove two beaver dams and two or so fallen trees. A little streambank erosion but normal. Recommend removal of dams. Contact Fish and Game.

United States Department of Agriculture
Soil Conservation Service
Federal Building
Durham, New Hampshire 03824

June 1, 1979

Mr. Joe B. Fryar
Chief, Engineering Division
U.S. Army, Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Fryar:

In response to your letter of May 18, 1979, we have reviewed the draft Phase I Inspection Report, National Dam Inspection Program, Oliverian Dam. The following are our comments:

1. The original hydrologic and hydraulic design assumptions were made in 1962. At that time, the structure was deemed to be a class b moderate hazard structure. We feel it met the Service guidelines at that time.

2. The asbuilt drawings for the structure show an extensive drainage system with a rock toe in the embankment. The structure has functioned properly since it was built in 1962. We therefore feel there is no need for an engineering investigation to verify the existence and effectiveness of the drainage system.

3. The trash rack at the principal spillway was designed in accordance with standards at that time. Later trash racks have a different design. However, we do feel that it is functional and there is no need for change.

We appreciate the opportunity to review this draft.

Sincerely,

Sidney G. Ferguson
for Donald G. Burbank
State Conservationist

B-2.22

OPY

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
White Mountain National Forest
P.O. Box 638, Laconia, N. H. 03246

REPLY TO: 7530 Dams

June 5, 1979

SUBJECT: Oliverian Dam, Benton, N. H.

TO: New England Division, Corps of Engineers
Attn: Joe B. Fryar, Chief, Engineering Division
424 Trapelo Road
Waltham, MA 02154

Enclosed is the draft inspection report copy for the Oliverian Dam, Benton, N. H., that you requested we return to you.

We are also enclosing a copy of the special use permit which was granted to the Grafton County Soil Conservation District and a copy of the Watershed Operation and Maintenance Agreement for the Oliverian Brook Watershed.

As stated in the special use permit, the U. S. Forest Service granted the Grafton County Soil Conservation District permission to construct, operate, and maintain the Oliverian Dam on National Forest lands. The U. S. Soil Conservation Service designed the dam and acts as an advisor for the Grafton County Soil Conservation District.

The role of the State of N. H. Water Resources Board is to provide for costs incurred in the operation and maintenance of this dam and to make dam inspections as needed.

If you have any further questions, please call this office, telephone number 603-524-6450.

for JAMES R. JORDAN
Forest Supervisor

Enclosures

OPY

B-2.23

COPY

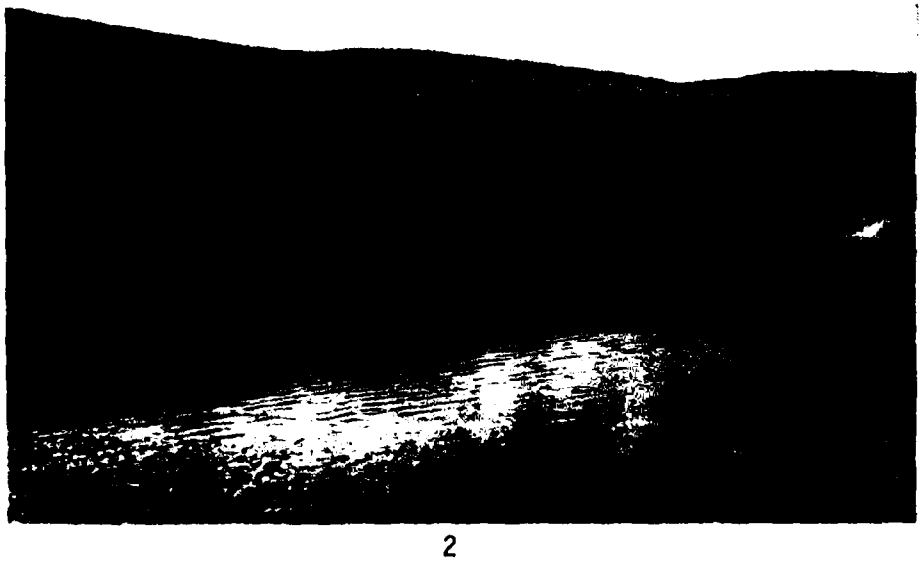
APPENDIX C

PHOTOGRAPHS

The following are photographs referenced in this report. See plan in Appendix B-1 for photograph locations and orientations.

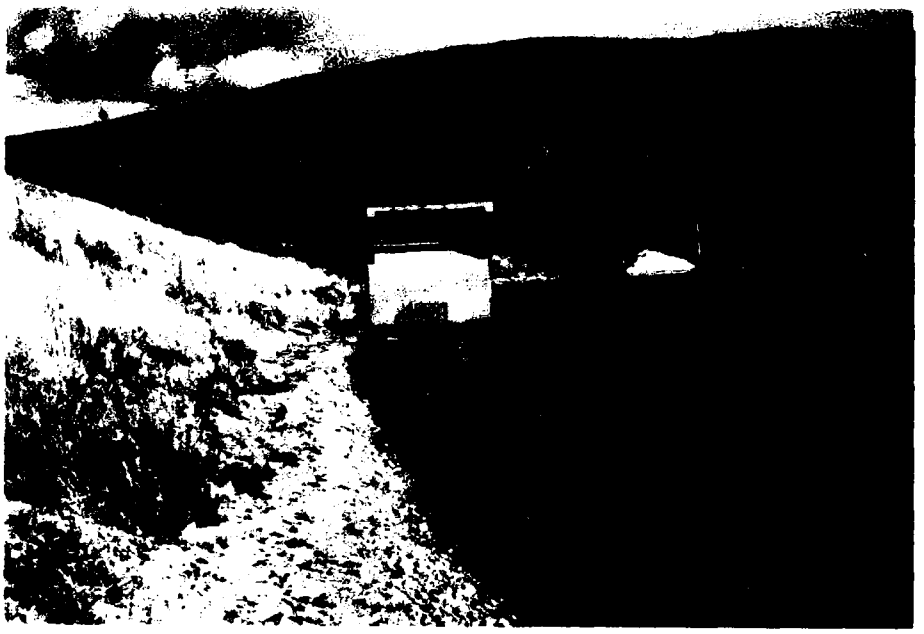
1

TOP OF DAM, LOOKING TOWARD EMERGENCY SPILLWAY



2

UPSTREAM FACE OF DAM; INLET TO EMERGENCY SPILLWAY IS AT RIGHT
NOTE CONSTRUCTION WASTE AREA

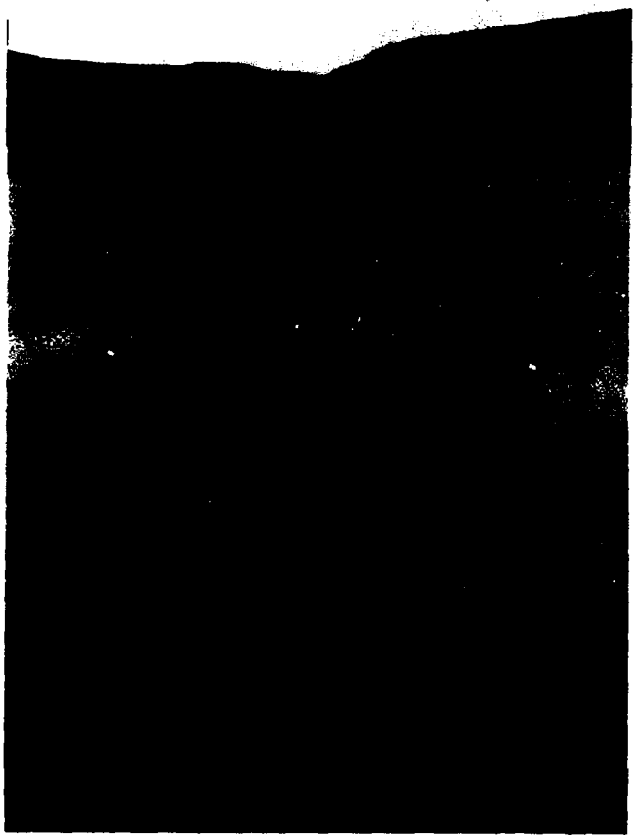


3

CONCRETE RISER SECTION OF PRINCIPAL SPILLWAY;
EMERGENCY SPILLWAY IN BACKGROUND

4

UPSTREAM FACE OF DAM, LOOKING TOWARD EMERGENCY SPILLWAY;
NOTE EROSION DUE TO HIGH WATER & ICE



5

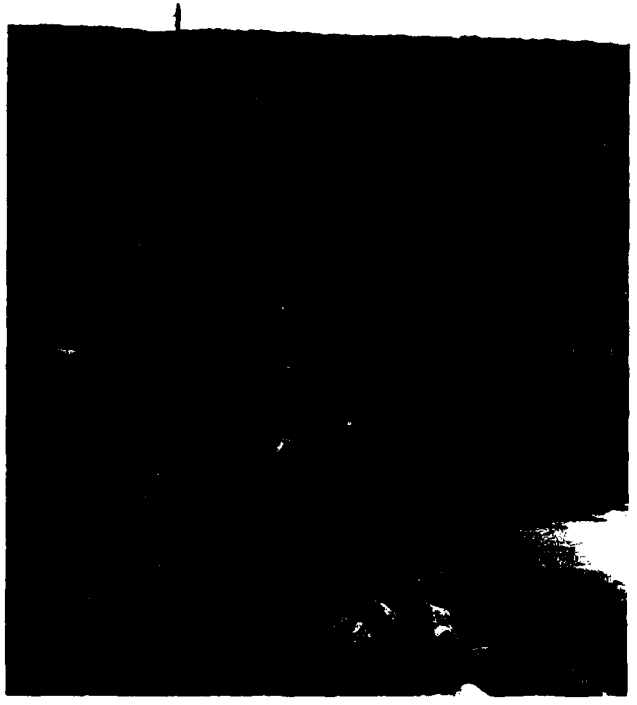
VIEW UPSTREAM FROM TOP
OF DAM

6

POND DRAIN GATE STEM AS SEEM FROM TOP OF CONCRETE RISER;
NOTE DAMAGE CAUSED BY ICE

7

INTERIOR OF CONCRETE RISER AS SEEN FROM ABOVE
OUTLET PIPE IS TOWARD TOP OF PHOTO



8

OUTLET PIPE. NOTE PATHWAY WORN
IN EMBANKMENT ABOVE PIPE

9

VIEW DOWNSTREAM FROM TOP OF DAM

10

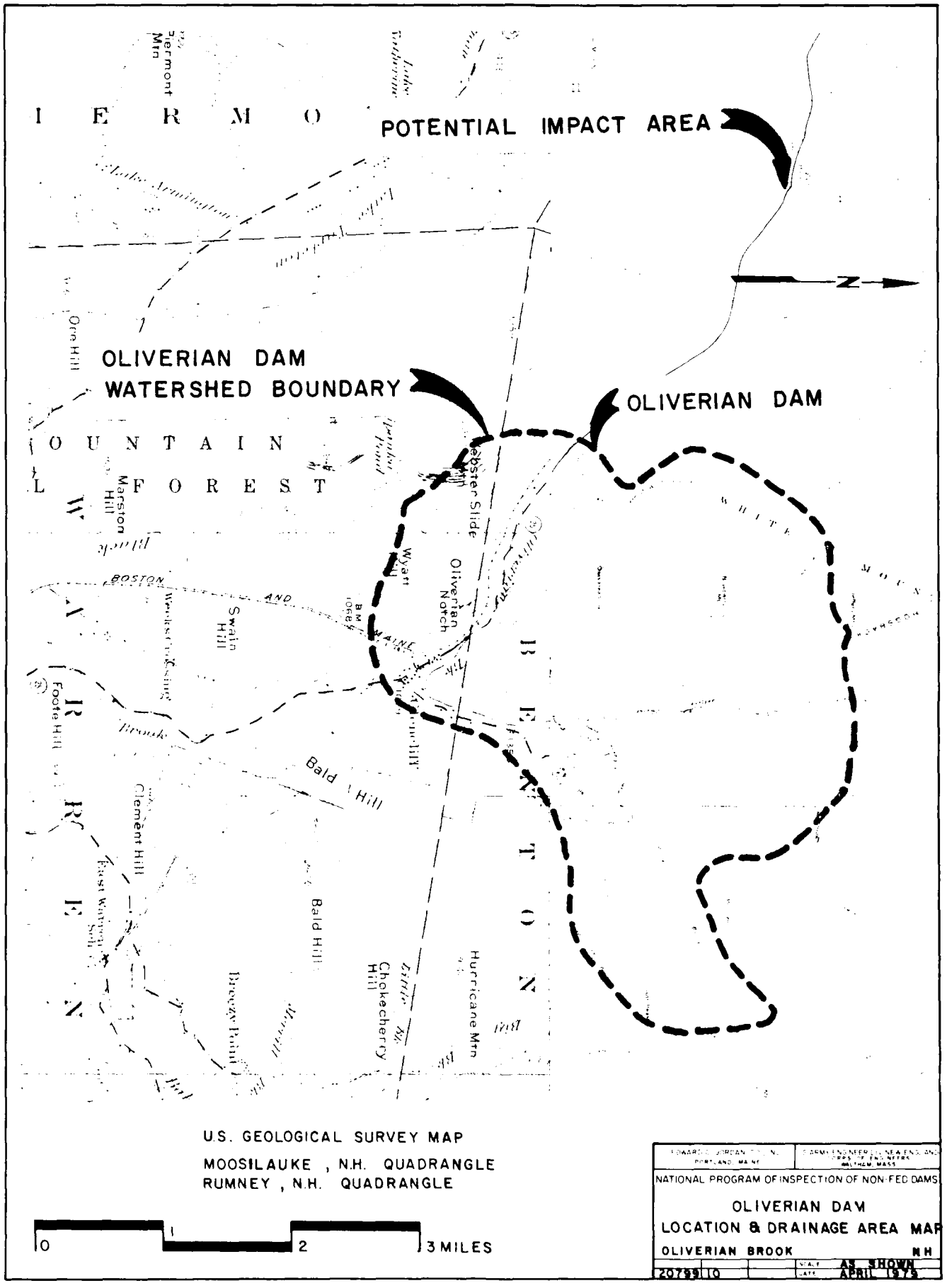
BRIDGE LOCATED IMMEDIATELY DOWNSTREAM FROM DAM

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Hydrologic computations pertinent to this investigation are attached. The following map shows the Oliverian Brook watershed at the Oliverian Dam.

Oliverian Dam


POTENTIAL IMPACT AREA
OLIVERIAN DAM
WATERSHED BOUNDARY
OLIVERIAN DAM
N
Webster Slide
Oliverian Notch
Wyatt
Swain Hill
Marston Hill
Foote Hill
Clement Hill
Bald Hill
Chokecherry Hill
Hurricane Mtn
Breezy Point
Ore Hill
Piermont Mtn
BOSTON AND MAINE
U.S. GEOLOGICAL SURVEY MAP
MOOSILAUKE , N.H. QUADRANGLE
RUMNEY , N.H. QUADRANGLE
0
1
2
3 MILES
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS
OLIVERIAN DAM
LOCATION & DRAINAGE AREA MAP
OLIVERIAN BROOK
NH
20799 10
AS SHOWN
APRIL 1979

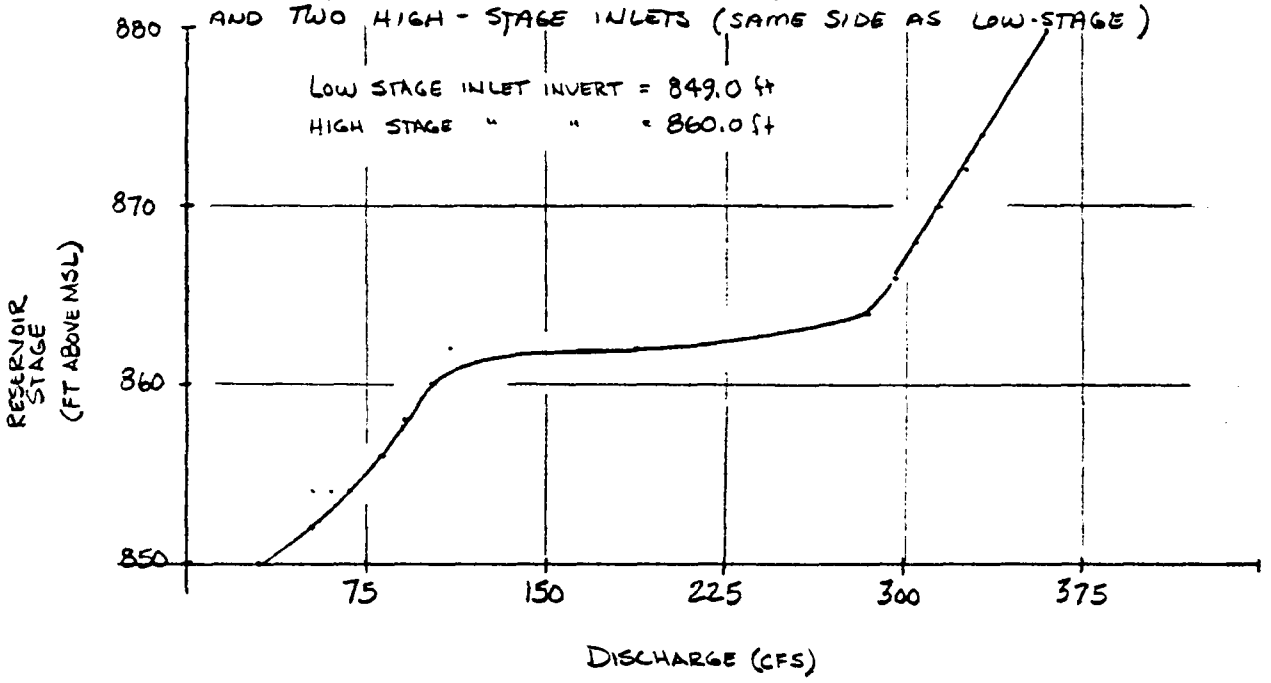
PROJECT	COMP. BY	JOB NO.
OLIVERIAN DAM HYDRAULICS	JJD	20799 -10
	CHK. BY S-S	DATE 3-26-79

HYDRAULICS

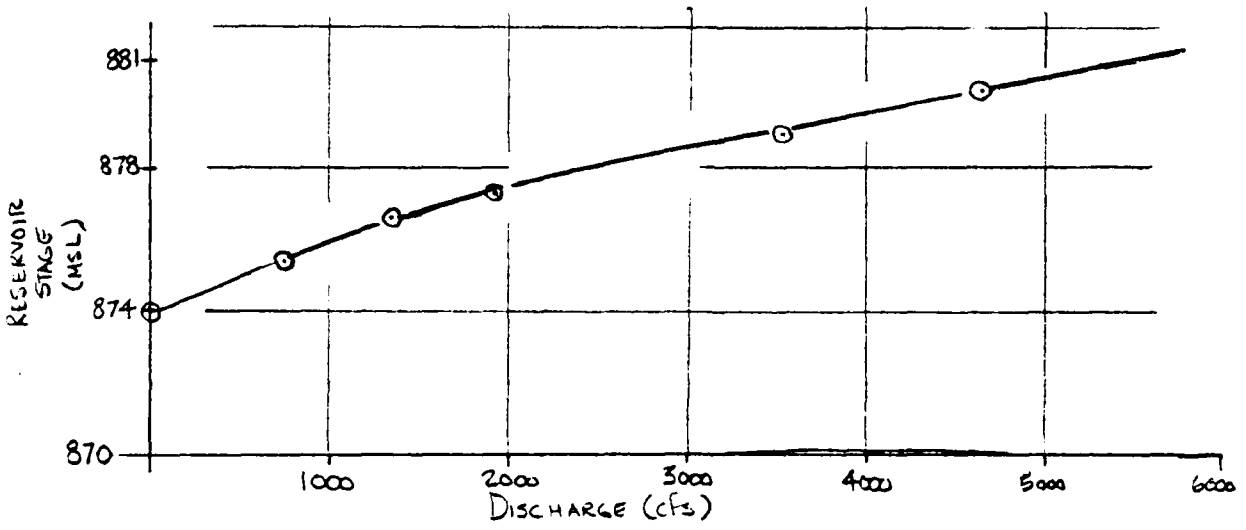
A. PRINCIPAL SPILLWAY DISCHARGE CAPACITY

CAPACITIES GIVEN AGREE WITH DISCHARGES GIVEN IN SCS DESIGN DATA PACKAGE

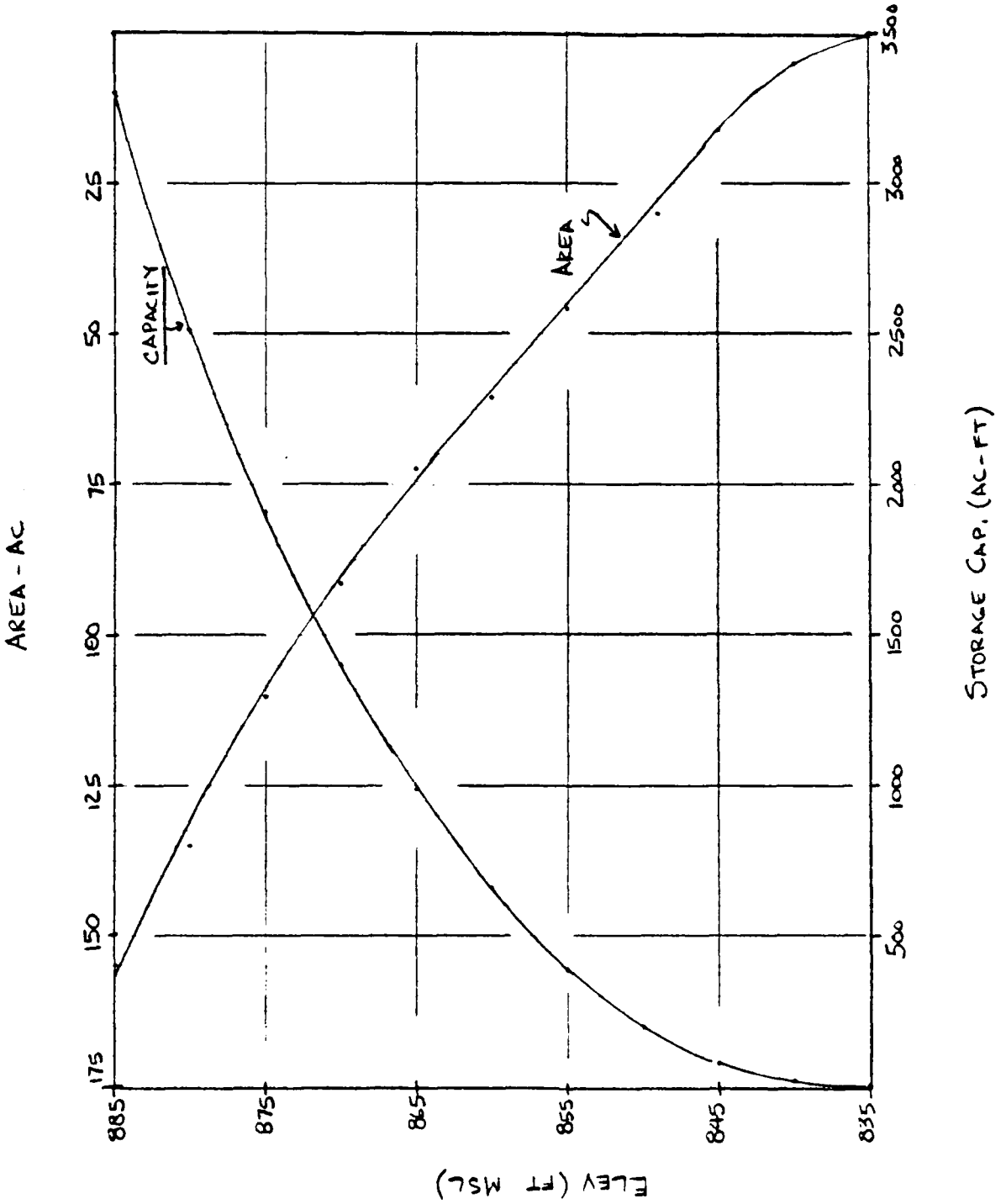
PRINCIPAL SPILLWAY CONSISTS OF 4 INLETS, TWO LOW-STAGE INLETS (ONE ON EITHER SIDE - NORTH, SOUTH, - OF THE CONCRETE RISER) AND TWO HIGH-STAGE INLETS (SAME SIDE AS LOW-STAGE)



B. EMERGENCY SPILLWAY DISCHARGE CAPACITY (FROM SCS DESIGN DATA)



PROJECT	COMP. BY	JOB NO.
OLIVERIAN DAM AREA-CAPACITY DATA	JJD	20799-10
	CHK. BY BTB	DATE 3-29-79



PROJECT	COMP BY	JOB NO.
OLIVERIANI DAM	JJD	20799-10
TEST FLOOD ANALYSIS	CHK BY BTB	DATE 2-8-79

TEST FLOOD ANALYSIS

DRAINAGE AREA = 10.6 SQ. MI.
DESCRIPTION - 'MOUNTAINOUS'
HAZARD CLASS. - HIGH
SIZE CLASS - INTERMEDIATE
TEST FLOOD - PMF

FROM CORPS OF ENGINEERS GUIDE CURVES :

PMF FLOW = 1,950 C.S.M
= 20,670 CFS

1/2 PMF = 10,335 CFS

ELEVATION - DISCHARGE - STORAGE DATA (FROM S.C.S. DESIGN DATA)

	USGS ELEV (FT)	PRINCIPAL + EMERG. SPILL. DISCHARGE (CFS)	SURCHARGE STORAGE (A-F)
	849	0	0
	850	31	31
	855	75	228
	860	101	496
	865	291	829
	870	315	1,240
	875 [1]	583	1,744
	876	1,019	1,867
	877	1,676	1,989
	878	2,511	2,112
	879	3,538	2,234
	880	4,656	2,357
TOP OF DAM	881	5,753	2,500
	882 [2]	8,902	2,648
	883	14,448	2,794
	884	21,329	2,939
	885		3,085

[1] SPILLWAY CREST AT ELEV 874.0 FT
[2] TREAT TOP OF DAM AS A WEIR WITH TRAPEZOIDAL CROSS-SECTION, ASSUME $C = 2.6$ AND $L = 900$ FT. FLOW OF PRINCIPAL SPILLWAY IS INSIGNIFICANT AT ELEV 882

PROJECT	COMP BY	JOB NO.
OLIVERIAN DAM TEST FLOOD ANALYSIS	JJD	20799-10
	CHK BY BTB	DATE 2/9/79

ESTIMATING EFFECT OF SURCHARGE STORAGE ON PMF

PEAK INFLOW, Q_{p1} = 20,670 CFS

HEIGHT TO PASS Q_{p1} = 883.9 MSL

$STOR_1 = 2{,}925 \text{ A-F} \times \frac{1}{10.6 \text{ mi}^2} \times \frac{1 \text{ mi}^2}{640 \text{ AC}} \times \frac{12 \text{ IN}}{\text{FT}} = 5.17 \text{ INCHES}$

$\therefore Q_{p2} = 20{,}670\left(1 - \frac{5.17}{19}\right) = 15{,}041 \text{ CFS}$

HEIGHT TO PASS Q_{p2} = 883.1 FT

$STOR_2 = 2{,}806 \text{ A-F} \times \frac{1}{10.6} \times \frac{1}{640} \times 12 = 4.96 \text{ IN}$

$(STOR_1 + STOR_2)/2 = 5.07 \text{ IN.}$

$\therefore Q_{p3} = 20{,}670\left(1 - \frac{5.07}{19}\right) = 15{,}160 \text{ CFS}$

HEIGHT TO PASS Q_{p3} = 883.1 FT

PMF OVERTOPS DAM BY 2.1 FT. PMF OUTFLOW = 15,160 CFS

ESTIMATING EFFECT OF SURCHARGE STORAGE ON 1/2 PMF

Q_{p1} = 10,335 CFS
HEIGHT TO PASS Q_{p1} = 882.3 FT
$STOR_1 = 2{,}686 \text{ A-F} \times \frac{1}{10.6} \times \frac{1}{640} \times \frac{12}{1} = 4.75 \text{ IN}$

$\therefore Q_{p2} = 10{,}335\left(1 - \frac{4.75}{9.5}\right) = 5{,}167 \text{ CFS}$

HEIGHT TO PASS Q_{p2} = 880.5 FT
$STOR_2 = \frac{2{,}424 \text{ A-F}}{10.6} \times \frac{12}{640} = 4.28$
$STOR_{AVG}$ = 4.5 IN $\therefore Q_{p3}$ = 5,439 CFS

HEIGHT TO PASS Q_{p3} = 880.7 FT 1/2 PMF OUTFLOW = 5,440 CFS

PROJECT	COMP BY	JOB NO.
OLIVERIAN DAM	JJD	20799-10
DAM FAILURE ANALYSIS	CHK BY BTB	DATE 2-7-79

DAM FAILURE ANALYSIS

(1) STORAGE AT TIME OF FAILURE = 2,500 ACRE-FEET (STORAGE ABOVE SED. POOL)

(2) PEAK FAILURE OUTFLOW, Q_{pl}

$$Q_{pl} = \frac{8}{27} W_b \sqrt{G}\, Y_o^{3/2}, \quad Y_o = 46 \text{ FEET}$$

W_b = 75 FEET (75 FOOT SECTION ADJACENT TO SPILLWAY IS ASSUMED TO FAIL)

$$Q_{pl} = \frac{8}{27}(75)(32.2^{1/2})(46^{3/2})$$

$$= 39{,}375 \text{ CFS}$$

(3) EMERGENCY SPILLWAY DISCHARGE PRIOR TO FAILURE

FROM S.C.S. DATA, Q_{ES} = 4,300 CFS AT ELEV 880.0 FT
(CREST OF DAM VARIES FROM ~880 TO ~881 MSL)

(4) PRINCIPAL SPILLWAY CAPACITY

FROM SCS DATA, Q_{ps} = 360 CFS (↑ INSIGNIFICANT) AT ELEV 880.0 FT

(5) TOTAL FLOW FROM FAILURE = 43,675 ≅ 44,000 CFS

(6) TIME FOR RESERVOIR TO EMPTY

$$T = \frac{12.1\, S}{\frac{1}{2} Q_p} = \frac{12.1\,(2500)}{\frac{1}{2}(43{,}675)} = 1.39 \text{ HOURS}$$

PROJECT	COMP BY	JOB NO.
OLIVERIAM DAM DAM FAILURE ANALYSIS	JJD	20799-10
	CHK BY RTB	DATE 2-7-79

CROSS-SECTION #1 (2900 FT. BELOW DAM)

$S = 2{,}500$ AC.-FT
$q_1 = 44{,}000$ CFS TRIAL STAGE = 14.1 FT

$$V_1 = \frac{7400 \times 2900}{43{,}560} = 493 \text{ AC.-FT.}$$

$$q_2 = 44{,}000\left(1 - \frac{493}{2500}\right) = 35{,}323 \text{ CFS}$$

$$V_2 = \frac{6360 \times 2900}{43{,}560} = 423 \text{ AC-FT}$$

$V_{AVG} = 458$ AC-FT

$$Q_1 = 44{,}000\left(1 - \frac{458}{2{,}500}\right) = 35{,}940 \text{ CFS}$$ STAGE = 13.4 FT

CROSS-SECTION #2 (8,400 FT BELOW DAM)

$S = 2{,}500$ A-F
$q_1 = 35{,}940$ CFS TRIAL STAGE = 10.3 FT.

$$V_1 = \left(\frac{8375 + 6433}{2}\right) \times \frac{5500}{43560} = 935 \text{ A-F}$$

$$q_2 = 35{,}940\left(1 - \frac{935}{2{,}500}\right) = 22{,}498 \text{ CFS}$$

$$V_2 = \left(\frac{6286 + 4819}{2}\right) \times \frac{5500}{43560} = 701 \text{ A-F}$$

$V_{AVG} = 818$

$$Q_2 = 35{,}940\left(1 - \frac{818}{2{,}500}\right) = 24{,}180 \text{ CFS}$$ STAGE = 9.5 FT.

PROJECT	COMP BY	JOB NO.
OLIVERIAN DAM	JJD	20799-10
DAM FAILURE ANALYSIS	CHK BY BTB	DATE 2/8/79

CROSS-SECTION #3 (2.2 MILES BELOW DAM)

$S = 2{,}500$ AC.-FT.

$q_1 = 24{,}180$ CFS TRIAL STAGE = 14.2 FT.

$$V_1 = \left(\frac{4560 + 6565}{2}\right) \times \frac{3200}{43560} = 409 \text{ A-F}$$

$$q_2 = 24{,}180\left(1 - \frac{409}{2500}\right) = 20{,}224$$

$$V_2 = \left(\frac{3953 + 5908}{2}\right) \times \frac{3200}{43{,}560} = 362 \text{ A-F}$$

$V_{AVE} = 386$ A-F

$$Q_3 = 24{,}180\left(1 - \frac{386}{2{,}500}\right) = 20{,}447 \text{ CFS}$$ STAGE = 13.6 FT.

CROSS-SECTION #4 (3.3 MILES BELOW DAM)

$S = 2{,}500$ AC-FT

$q_1 = 20{,}447$ CFS TRIAL STAGE = 793.4

$$V_1 = \left(\frac{4046 + 3986}{2}\right) \times \frac{5800}{43{,}560} = 535 \text{ A-F}$$

$$q_2 = 20447\left(1 - \frac{535}{2500}\right) = 16{,}071 \text{ CFS}$$

$$V_2 = \left(\frac{3371 + 3332}{2}\right) \times \frac{5800}{43560} = 446 \text{ A-F}$$

$V_{AVE} = 491$ A-F

$$Q_4 = 20{,}447\left(1 - \frac{491}{2500}\right) = 16{,}431 \text{ CFS}$$

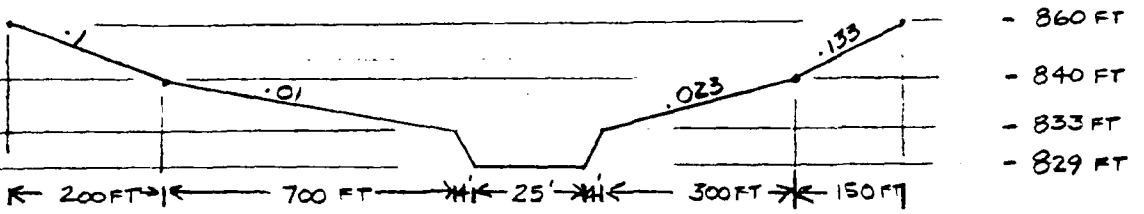
STAGE = 12.6 FT

STAGE OF 12.6 FT AT THE TOWN OF EAST HAVERHILL, N.H. CONSIDERABLE DAMAGE IS LIKELY TO RESULT WITH THE CHANCE OF LOSS OF MANY LIVES. HAZARD CLASS. — "HIGH"

PROJECT	COMP BY	JOB NO.
OLIVERIAN DAM DAM FAILURE ANALYSIS	JJD	20799-10
	CHK BY ET3	DATE 2/7/79

CROSS-SECTION # 1
(LOCATED APPROX. 2,900 FT BELOW DAM)
(NOT TO SCALE)

OVERALL $n = .050$
$S = .0033$



W.S. ELEV. (FT)	$\frac{1.486}{n}$	A	P	R	S	Q
833	29.7	116	36	3.22	.0033	428 CFS
835	29.7	469	323	1.45	.0033	1,023 CFS
837	29.7	1,396	610	2.29	.0033	4,116 CFS
839	29.7	2,897	897	3.23	.0033	10,722
840	29.7	3,863	1,036	3.73	.0033	15,720
841	29.7	4,905	1,054	4.65	.0033	23,104
842	29.7	6,036	1,071	5.64	.0033	32,277
843	29.7	7,113	1,089	6.53	.0033	42,380

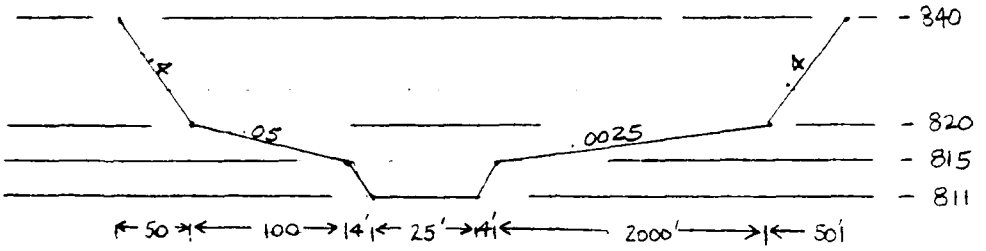
335 : $A = 116 + 200 + 66 + 87(2)(.5) = 469$, $P = 36 + 200 + 87 = 323$
837 : $A = 469 + 200 + 87 + 2(320) = 1,396$, $P = 323 + 287 = 610$
839 : $A = 1,396 + 200 + 87 + 2(607) = 2,897$, $P = 610 + 287 = 897$
840 : $A = 2897 + 50 + 22 + 894 = 3,863$, $P = 897 + 139 = 1,036$
842 : $A = 3935 + 20 + 15 + 2(1033) = 6,036$, $P = 1036 + 35 = 1,071$
843 : $A = 6036 + 5 + 3.8 + 1(1,068) = 7,113$, $P = 1071 + 18 = 1,089$
841 : $A = 3863 + 5 + 3.8 + 1(1033) = 4,905$, $P = 1036 + 18 = 1,054$

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY	JOB NO.
OLIVERIAN DAM DAM FAILURE ANALYSIS	JJD	20799-10
	CHK BY BTB	DATE 2-8-79

CROSS-SECTION #2
(8,400 FEET BELOW DAM)
(NOT TO SCALE)

$\eta = .050$
$S = .0034$

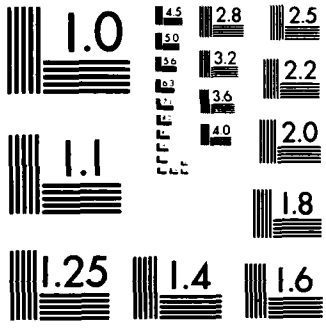


W.S. ELEV. (FT)	1.486/η	A (FT²)	P	R	S	Q
815	29.7	116	36	3.22	.0034	435
817	29.7	1,022	876	1.17	.0034	1,963
819	29.7	3,608	1,716	2.10	.0034	10,196
820	29.7	5,531	2,136	2.59	.0034	17,948
821	29.7	7,667	2,141	3.58	.0034	30,815
822	29.7	9,807	2,147	4.57	.0034	46,300

817 : $A = 116 + 40 + 800 + 66 = 1,022$, $P = 36 + 800 + 40 = 876$
819 : $A = 1,022 + 40 + 800 + 873(2) = 3,608$, $P = 876 + 800 + 40 = 1,716$
820 : $A = 3608 + 10 + 200 + 1713 = 5,531$, $P = 1,716 + 20 + 400 = 2,136$
822 : $A = 5,531 + 10 + 2,133(2) = 9,807$, $P = 2,136 + 11 = 2,147$
821 : $A = 5,531 + 2.5 + 2133 = 7,667$, $P = 2,136 + 5 = 2,141$

AD-A156 402 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
OLIVERIAN DAM (NH-002 (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV MAY 79

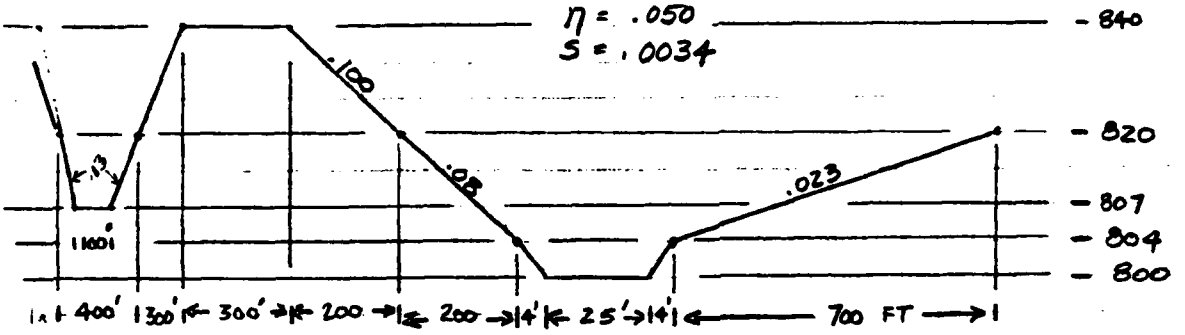
UNCLASSIFIED F/G 13/13 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

PROJECT	COMP BY	JOB NO.
OLIVERIAN DAM	JJD	20799-10
DAM FAILURE ANALYSIS	CHK BY BTB	DATE 2-8-79

CROSS-SECTION #3
(2.2 MILES BELOW DAM)

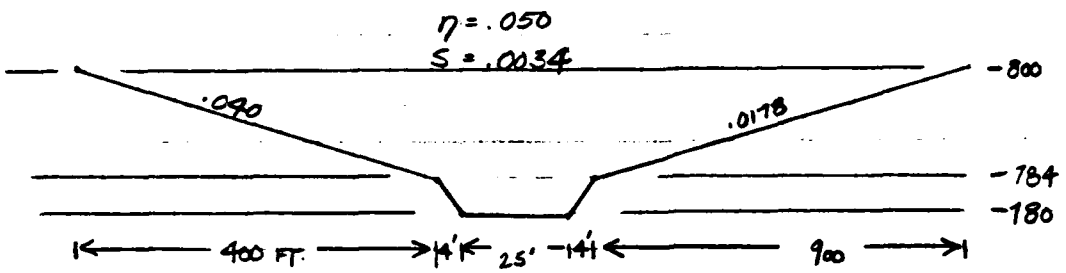


W.S. ELEV (FT.)	1.486/n	A	P	R	S	Q
804	29.7	116	36	3.22	.0034	435
806	29.7	294	148	1.99	.0034	801
808	29.7	804	375	2.14	.0034	2,303
810	29.7	1,691	518	3.26	.0034	6,394
811	29.7	2,240	589	3.80	.0034	9,363
812	29.7	2,863	660	4.34	.0034	13,064
813	29.7	3,558	731	4.87	.0034	17,517
814	29.7	4,326	802	5.39	.0034	22,773

806 : $A = 116 + 25 + 87 + 66 = 294$, $P = 36 + 87 + 25 = 148$
807 : $A = 294 + 6 + 22 + 145 = 467$, $P = 148 + 44 + 12 = 204$
808 : $A = 467 + 6 + 22 + 201 + 108 = 804$, $P = 204 + 44 + 12 + 115 = 375$
810 : $A = 804 + 25 + 87 + 2(257) + 230 + 31 = 1691$, $P = 375 + 87 + 25 + 31 = 518$
811 : $A = 1691 + 6 + 22 + 368 + 145 + 8 = 2240$, $P = 518 + 44 + 12 + 15 = 589$
812 : $A = 2240 + 6 + 22 + 425 + 162 + 8 = 2863$, $P = 589 + 44 + 12 + 15 = 660$
813 : $A = 2863 + 28 + 482 + 177 + 8 = 3,558$, $P = 660 + 44 + 12 + 15 = 731$
814 : $A = 3558 + 28 + 539 + 193 + 8 = 4,326$ $P = 731 + 44 + 12 + 15 = 802$

PROJECT	COMP BY	JOB NO.
OLIVERIAN DAM DAM FAILURE ANALYSIS	JJD	20799-10
	CHK BY BTB	DATE 2-8-78

CROSS-SECTION #4
(3.3 MILES BELOW DAM)



W.S. ELEV.	1.486/n	A	P	R	S	Q
784	29.7	116	36	3.22	.0034	435
786	29.7	344	198	1.74	.0034	858
788	29.7	896	360	2.49	.0034	2,832
790	29.7	1,772	522	3.39	.0034	6,869
792	29.7	2,972	684	4.35	.0034	13,581
793	29.7	3,694	765	4.83	.0034	18,085
794	29.7	4,497	846	5.32	.0034	23,470

A :
786 : A = 116 + 50 + 112 + 66 = 344 ,
788 : A = 344 + 50 + 112 + 2(195) = 896 ,
790 : A = 896 + 50 + 112 + 2(357) = 1,772 ,
792 : A = 1,772 + 162 + 2(519) = 2,972 ,
793 : A = 2,972 + 41 + 1(681) = 3,694 ,
794 : A = 3,694 + 41 + 1(762) = 4,497 ,

P = 36 + 50 + 112 = 198
P = 198 + 162 = 360
P = 360 + 162 = 522
P = 522 + 162 = 684
P = 684 + 81 = 765
P = 765 + 81 = 846

APPENDIX E

Information as Contained in the National Inventory of Dams

END

FILMED

8-85

DTIC